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# Hawaii Coastal Zone Management Program

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Technical supplement 14

Determining The Inland Extent Of Hawaii's  
CZM Boundaries

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DETERMINING THE INLAND EXTENT OF HAWAII'S  
COASTAL ZONE BOUNDARIES

by

Brian Nishimura

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Hawaii Coastal Zone Management Program

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## TABLE OF CONTENTS

I.	Introduction .....	1
	The boundary issue in historical perspective .....	1
	The Stratton Commission of 1969 .....	2
	The Coastal Zone Management Act of 1972 .....	4
	Hawaii's early CZM efforts .....	8
	The Shoreline Protection Act of 1975 .....	8
	The Hawaii Coastal Zone Management Act of 1977 .....	10
	The current status of Hawaii's CZM Program .....	16
	Purpose and organization of this report .....	20
II.	A national perspective .....	23
	Federal requirements .....	23
	Program management and boundary schemes .....	26
	Analysis of the boundary options .....	37
	Fixed linear distances .....	37
	Political/cultural boundaries .....	37
	Elevation .....	38
	Natural features/natural resources areas .....	39
	Natural processes .....	39
	Summary .....	40
III.	Summary of alternatives for interpreting Hawaii's CZM Law ...	43
	Coastal Ecosystems .....	44
	Coastal ecosystems and coastal hazards .....	49
	Coastal ecosystems, coastal hazards, coastal recreational resources, coastal scenic and open space resources, and economic uses .....	53
IV.	Boundary criteria .....	65
	Recreation resources .....	65

Inland waters .....	67
Shoreline features .....	70
Bottom subtypes .....	75
Scenic and open space resources .....	77
Ecosystems .....	86
Critical coastal ecosystems .....	89
Coastal hazards .....	98
Economic uses .....	102
Summary .....	103
Criteria .....	103
V. Guidelines for implementing the criteria .....	109
Criterion 1 .....	110
Criterion 2 .....	113
Criterion 3 .....	114
Criterion 4 .....	116
Criterion 5 .....	117
VI. Applying the criteria .....	125
Coastal recreation .....	127
Coastal scenic and open space resources .....	130
Coastal ecosystem .....	130
Coastal hazards .....	130
Economic importance .....	131
A comparison of boundaries .....	131
VII. Endnotes .....	139
Section I Endnotes .....	139

Section II Endnotes .....	145
Section III Endnotes .....	147
Section IV Endnotes .....	149
Section V Endnotes .....	157
Section VI Endnotes .....	161
VIII. Bibliography .....	165

## TABLE OF TABLES

II. A national perspective .....	23
State approaches to the number of boundary tiers, Coastal Zone Management Programs .....	30
State approaches to the designation of planning areas, Coastal Zone Management Programs .....	32
State approaches to the designation of permit areas, Coastal Zone Management Programs .....	34
State approaches to the designation of permit and planning boundary combined, Coastal Zone Management Programs .....	36
III. Summary of alternatives for interpreting Hawaii's CZM Law ...	43
Alternative two: Range of options for boundary criteria based on hazards .....	52
Options for organizing the boundary criteria: Recreation, scenic and open space and economic use elements .....	61
Summary table .....	63
IV. Boundary criteria .....	65
Obligate hydrophytes recently observed in Hawaii's coastal wetlands .....	71
Scenic and open space resources .....	82
Hawaiian streams of high natural quality .....	90
Examples of plants on the proposed endangered species list which are found in coastal ecosystems .....	95
V. Guidelines for implementing the criteria .....	109
Summary of sources for implementing the boundary criteria ..	119



## TABLE OF FIGURES AND MAPS

III. Summary of alternatives for interpreting Hawaii's CZM Law ...	43
Alternatives for organizing the Coastal Zone Management boundary criteria .....	48
IV. Boundary criteria .....	65
Recreation resources identified by function/activity and resource characteristics .....	68
VI. Applying the criteria .....	125
Coastal recreation .....	133
Coastal scenic and open space resources .....	134
Coastal ecosystems .....	135
Coastal hazards .....	136
Economic analysis .....	137
Composite .....	138



## INTRODUCTION

No single issue has generated more controversy throughout the development of Hawaii's Coastal Zone Management (CZM) Program than that of determining an inland boundary for coastal management purposes. And, although Hawaii has both adopted a CZM program through law, and is in the process of obtaining federal program approval, the issue remains unresolved. Why it persists at this stage in the program may be best understood by examining it within the context of the historical development of the national CZM program and the state CZM program in Hawaii.

## THE BOUNDARY ISSUE IN HISTORICAL PERSPECTIVE

A national program for the management of coastal resources was established by Congress with the enactment of Public 92-583, better known as the Coastal Zone Management Act (CZMA) of 1972.<sup>1</sup> Recognizing that increased human demands for the use of finite coastal resources often resulted in environmental degradation and losses of valuable coastal resources, Congress declared it national policy:

- (a) to preserve, protect, develop, and where possible to restore or enhance, the resources of the nation's coastal zones for present and succeeding generations;
- (b) to encourage and assist the states in effectively exercising their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and aesthetic values as well as to needs for economic development;
- (c) for all Federal agencies engaged in programs affecting the coastal zone to cooperate and participate with state and local government and regional agencies in effectuating the purposes of this title; and
- (d) to encourage the participation of the public, of Federal, State, and local governments, and of regional agencies in the development of coastal

zone management programs. With respect to implementation of such management programs, it is the national policy to encourage cooperation among the various state and regional agencies including establishment of inter-state and regional agreements, cooperative procedures, and joint interaction particularly regarding environmental problems.<sup>2</sup>

Although unintended as such, the CZM Act 1972 is considered to be a landmark in federal land planning and environmental control legislation,<sup>3</sup> and represents a major effort to manage the nation's coastal resources.

#### The Stratton Commission of 1969

Responding to concerns about the potential crises facing the nation's shorelines and the need for a broad-based national ocean policy, Congress, in 1969, established a Commission on Marine Science, Engineering and Resources.<sup>4</sup> The Commission, which became known as the Stratton Commission, after its chairman, Julius Stratton, was charged with the responsibility of studying, formulating, and recommending a national ocean policy.<sup>5</sup> The CZMA of 1972 was enacted, in part, as a response to the recommendations of the Stratton Commission.

Although the focus of the Stratton Commission was originally directed toward the promotion and use of marine resources, its members became deeply concerned during the course of their deliberations with the protection and beneficial management of coastal resources. The Commission, interpreting its mandate broadly, examined a range of the nation's civil marine interests, including resource development, environmental protection, the maintenance of environmental quality, and recreation, transportation, and military uses of the oceans. Whereas previous technical reports had focused on the deep oceans, the Commission concluded that it was the nation's coasts, estuarine areas, and Great Lakes which presented the most urgent problems as well as the most immediate and tangible opportunities for improvement.

The Commission viewed the coastal zone as a transitional region between two different environments, the land and sea.<sup>6</sup> It defined the coastal zone as that part of the land affected by its proximity to the sea, and that part of the ocean affected by its proximity to the land.<sup>7</sup> Taking this definition of the coastal zone and reviewing the competition among uses for these areas, the Commission noted:

The uses of the coastal zone are increasing.  
This trend will continue and probably accelerate.

The increasing pressure on the coastal zone is causing an increasing variety of management problems. Some uses of the coastal zone are in conflict and some uses may be incompatible with one another. As we look to the future, one can see that these management problems will increase.<sup>8</sup>

One of the primary management problems observed by the Stratton Commission lay in the fragmented system of regulations controlling uses of the coastal zone. The Commission concluded that although federal, state and local governments shared the responsibility to develop and manage the coastal zone, effective management had been thwarted by the variety of jurisdictions involved at all levels of government, the low priority afforded to marine matters by state governments, the proliferation of responsibilities among state agencies, and the failure of state agencies to develop and implement long-range plans.<sup>9</sup> Accordingly, in its final report, OUR NATION AND THE SEA - A PLAN FOR ACTION,<sup>10</sup> the Commission called for a national coastal zone management program.

The Stratton Commission's recommendations outlined strategies for the management of the coastal zone directed toward providing an improved and coordinated regulatory program for these areas.<sup>11</sup> The report called for a federal coastal zone program which would set program standards, make funds available for planning and implementation on the state level, and provide for federal review of state programs to determine compliance with federal guidelines. Although it also suggested that federal legislation permit variety in state organizational structures, the report emphasized the need for a state coastal authority in order to coordinate the diffusion of responsibilities for coastal areas among counties, municipalities, and independent agencies.<sup>12</sup>

Congress first acted on the recommendation of the Stratton Commission in 1970 with the introduction of a bill outlining the elements of a national program for coastal zone management.<sup>13</sup> This bill provided minimal direction concerning methods for state regulation, but did not receive floor consideration.

In 1971, the bill was reworked and introduced in the Senate as Senate Bill 582 (S.B. 582).<sup>14</sup> S.B. 582 was patterned after the American Law Institute's (ALI) proposal for state controls over land development.<sup>15</sup> Unlike the ALI proposal, S.B. 582 limited state intervention to coastal areas. It also failed to indicate the amounts of initiative to be exercised by local governments in the control of development in coastal zones. Instead, the problem was left to the

states to resolve, an omission which conflicted with the Stratton Commission's emphasis on the need for a local government role in the program. Pollution control, specifically regarding water pollution, one of the major coastal management problems reviewed by the Commission, was another subject with which S.B. 582 did not deal in depth. S.B. 582 was reported out by the Senate Commerce Committee,<sup>16</sup> but was not debated on the floor.

### The Coastal Zone Management Act of 1972

In 1972, the national program for coastal zone management was finally established with the enactment of Public Law 92-583, better known as the Coastal Zone Management Act (CZMA) of 1972.<sup>17</sup>

During this Congressional session, which saw the passage and enactment of the CZMA, however, two bills related to coastal zone management, one introduced in the Senate,<sup>18</sup> the other in the House of Representatives,<sup>19</sup> were first reviewed by Congress. Although fairly similar in content, the bills differed in the choice of federal agency to which administration of the bill was delegated. The bill introduced in the House placed administration in the Department of the Interior, while the bill introduced in the Senate called for administration by the Department of Commerce, with the administration of the law to be carried out by the newly-created National Oceanic and Atmospheric Administration (NOAA).

This difference reflects, in part, discussions concerning the relationship between coastal zone legislation and the national land use policy bill,<sup>20</sup> which was introduced during the same congressional session. Senate sponsors viewed coastal zone legislation as an independent complement to the proposed national land use control policy bill.<sup>21</sup> House sponsors, on the other hand, viewed coastal zone management as a restricted extension of the more comprehensive land use policy bill.<sup>22</sup> Whereas the Senate's version implied a CZM program encompassing broader land management considerations, the House version implied a program limited to marine or coastal affairs.

These and other policy conflicts were eventually resolved in the conference committee which considered the CZMA.<sup>23</sup> As enacted in the legislation, administration of the national CZM program was placed in the Department of Commerce. However, should the national land use policy bill be enacted, concurrence in the coastal zone program would have to be obtained from the federal agency administering that bill.<sup>24</sup>

Under the CZMA, the Secretary of Commerce was authorized to administer the coastal zone management program. The responsibility

for operating the program was then delegated to the National Oceanic and Atmospheric Administration (NOAA), Office of Coastal Zone Management (OCZM).

The CZMA differs from companion federal pollution control acts in that it details the participation by local governments in the national program.<sup>25</sup> Among the noteworthy features of this element of the CZMA is the set of provisions calling for federal consistency.<sup>26</sup> Under these provisions, activities occurring in a state's coastal zone which are conducted, licensed, or assisted by federal agencies must be consistent, to the maximum extent practicable, with the provisions of that state's CZM program.

Although the consistency provisions apply only to states having federally-approved CZM programs, they nevertheless represent a significant change in federal policy. The importance of these provisions is that they modify the "supremacy clause" which, by tradition, gave federal law precedence over state legislation in situations where they conflict. Historically, federal agencies were not legally required to consider state law when performing their functions and responsibilities, including undertaking projects for which federal lands were purchased. Congress, through the adoption of the consistency provisions, initiated changes in the relationship by providing states with limited control over federally-conducted or supported activities occurring in their coastal zones.

The programs authorized under the CZMA are characterized by four features. First, participation in the national program is voluntary. To encourage state participation in the national program, three types of grants are currently made available to coastal states.<sup>27</sup> The first type, under Section 305 of the CZMA, makes annual grants available to each of the coastal states and territories for the purpose of assisting in the development of management programs for the land and water resources of the coastal zone. These grants now finance up to four-fifths of the program development costs, with the participating states and territories providing the balance.<sup>28</sup> After developing its management program, a state must submit the program to the Secretary of Commerce for review and approval. Upon approval of the management program, the state becomes eligible for the second type of grant, under Section 305 of the CZMA, which provides funds for implementing the program. The third type of grant, under Section 315 of the CZMA, authorizes the Secretary of Commerce to make funds available to states for up to 50% of the costs of acquisition of access to beaches and other public coastal areas of environmental, recreational, historical, aesthetic, ecological or cultural value, and for the preservation of islands. These funds can also be used for the acquisition, development, and operation of estuarine sanctuaries.<sup>29</sup>

In order to qualify for these grants, states must first demonstrate their capabilities by developing their own CZM programs. However, coastal states are not mandated to develop their own programs or to participate in the national program.

A second feature of CZMA programs is that they are not directed solely at environmental protection. Recognizing the importance of both economic development and conservation-oriented uses, an attempt is made to reconcile demands for economic development with the need for coastal protection.<sup>30</sup>

Thirdly, the CZMA establishes Federal requirements regarding the management processes which must be addressed in a state program. However, it does not mandate specific land and water management decisions on the part of the participating states.

Finally, although the CZMA is primarily a management program for coastal waters, it is also intended to cover adjacent shoreline areas to the extent that uses of shorelands affect coastal waters. The program established under the CZMA, therefore, includes land management guidelines.

Defining the coastal zone area to which the regulatory system of the CZM program applies continues to pose special problems of its own, on both national and local levels. Coastal zone studies have emphasized the interrelationship between planning and control of coastal zones and planning and control of adjacent land areas. Yet, the CZMA is directed primarily at coastal areas. This can complicate the administration of the legislation, especially in cases where trade-offs must be made between relocating development activities inland to avoid siting them in coastal areas.

The CZMA, adopting the general analysis of the coastal zone set by the Stratton Commission, also defines the coastal zone as "the coastal waters...and the adjacent shorelands...strongly influenced by each other."<sup>31</sup> The seaward boundary of the coastal zone has been accepted as the international boundary in the Great Lakes and the outer limits of U.S. territorial jurisdiction in the oceans. Defining the inland boundary, however, has been more complicated. An earlier definition placed the inland boundary at a seven-mile limit.<sup>32</sup> This limit was changed to the present CZMA definition, which states, "The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters".<sup>33</sup>

This new definition of inland boundaries was made by Congress in order to permit the states maximum flexibility in coastal zone



designation. NOAA guidelines for the administration of the CZMA indicate that states must recognize the many factors which may enter into the determination of inland boundaries.<sup>34</sup> They include considerations of three longitudinal zones - open water, estuarine, and shorelines, each of which present problems of delineation. The existing limits of natural systems, jurisdictional units, and social neighborhoods, and the interrelationships among them must also be taken into account. Moreover, a larger planning area than is normally covered under municipal or county designations must be utilized in order to address the impacts which may occur.

In spite of the flexibility permitted by the CZMA, designation of the coastal zone area remains troublesome. The definition of the inland boundary of the coastal zone espoused by the CZMA does not indicate whether, and to what extent, the CZM program applies to urban and urbanized lands along the coasts. In general, the regulatory objective of a state's CZM program depends on the character of its coastal areas. CZM programs in undeveloped coastal areas may concentrate on resource protection, while programs in urban areas may focus on the development of policies regarding the planning and regulation of urban development.

Other physical characteristics of a state's coastal areas also complicate the process of delineating coastal zone boundaries. Problems may be simpler to address in states where ecologically sensitive coastal areas can be relatively easily defined. In states, such as those located on the West Coast, however, coastal areas are dry, making it difficult to delineate an ecologically independent coastal strip. In other states, such as Louisiana, where coastal areas can extend as far as 80 miles inland, lands which exhibit no visual connection with the ocean may be subject to the requirements of the CZMA.

Jurisdictional considerations also pose complications. In states where relatively small local governmental units are found along the coastline, local government boundaries may define the area in which the state's CZM program applies. In states with larger local units, the boundaries may divide county areas. Integrating CZM land development regulations with those applicable throughout the counties requires cooperation and coordination among state and local governments.

In Hawaii, where technical as well as jurisdictional considerations have affected the process, establishing the inland coastal boundaries for the state program has been lengthy and at times divisive, involving discussions of an ever-evolving set of complex issues.

### Hawaii's Early CZM Efforts

In 1972, in response to the federal CZMA, the Governor of Hawaii designated the State Department of Planning and Economic Development (DPED) as the agency responsible for applying for the federal matching grants available through the CZMA for developing a statewide coastal management program. With the adoption of Act 164, SLH 1978, the State Legislature authorized the DPED to prepare a coastal zone management program for Hawaii. Act 164, SLH 1973 mandated that the program developed by DPED comply with the requirements of the federal CZMA and provide guidance to the State and counties for administering their authority in the coastal zone.

The DPED received federal and state funds to begin coastal zone management planning during the latter part of 1974. A CZM Policy Advisory Committee, composed of the four county planning directors, two state legislators, and representatives of all State agencies responsible for regulating uses of Hawaii's lands and waters, was formed in March 1975 during this initial period of program development.

Since its initial stages, the development of Hawaii's CZM program has in itself been controversial. Several concerns regarding the program have been expressed by members of the public and private sectors since the early days of program development. The four county governments have maintained that the CZM program could be used by the State to usurp traditional county control over land use. Landowners and members of the construction industry have complained that the program will subject coastal development to excessive and unnecessary regulation. And citizens and community organizations have expressed doubts that their concerns over the adequacy of government regulation of coastal development will be heard or heeded.

### The Shoreline Protection Act of 1975

Shortly after the State's first-year CZM program planning activities commenced, Hawaii's Shoreline Protection Act (SPA) of 1975 was enacted.<sup>35</sup> This act was adopted to provide interim controls within an area along the shoreline while the formal State CZM program was being developed.

The initiative for this legislation came largely as a result of the efforts of the Council of Presidents (COP), a loosely-knit coalition of the presidents of community organizations located primarily on the Island of Oahu. The COP was motivated by concerns that the State's CZM program could not be developed and enacted in time to prevent permanent losses of valuable coastal resources. It was feared that during the period in which Hawaii's CZM program was being developed,

much destructive and speculative development would take place - a rush to speculate during the interim period could ruin much of the shoreline which would be protected by the CZM program.

Members of the COP drafted the initial bill proposed to the Legislature, using as a model California's statewide plan for shoreline protection, Proposition 20, which had been adopted in 1972.<sup>36</sup> One provision of the California plan established an autonomous state Coastal Commission responsible for developing California's CZM program and issuing permits for all coastline development. Another provision set the inland boundary, within which the regulatory system of the plan applied, at 1,000 yards from the ocean. These two provisions were incorporated into the legislative proposal that was drafted by the COP for Hawaii. Major elements of the proposed Shoreline Protection bill for Hawaii included the delineation of a 1,000 yard minimum inland boundary in which development would be subject to permit review, and the establishment of a coastal commission to assume planning of Hawaii's CZM program and to evaluate permit applications.

Supporters of the bill stressed the importance of these provisions as interim protective measures. Nevertheless, the proposal was met with strong opposition from developers as well as county governments and the state. Some opponents argued that the bill would create another unwieldy layer of bureaucratic red tape. Existing state and county regulations were argued to be adequate for protecting Hawaii's shorelines during the interim period. Imposing this additional layer of regulations, it was feared, would result in a slowdown of economic development needed by the State. Other opponents objected to the arbitrary establishment of a 1,000 yard boundary for the regulatory system. The DPED objected to the establishment of a new coastal commission, declaring the preparation of Hawaii's CZM program to be legitimately mandated to the Department and a proper function of its ongoing statewide planning process.<sup>37</sup>

To resolve the conflicting positions taken by citizens, developers, county representatives, and the DPED, the Legislature enacted a compromise bill. This bill, which became known as the Shoreline Protection Act, retained the permit requirement but drastically reduced the minimum boundary requirement from 1,000 yards to 100 yards. In addition, rather than creating a new coastal commission, CZM activities were structured within existing agencies. Responsibility for CZM planning was left with DPED, and permit review authority was delegated to the counties.

The Shoreline Protection Act instructed the counties to establish Special Management Area (SMA) boundaries. The SMA is defined in the SPA as follows:

'Special management area' means the land extending not less than one hundred yards inland from the 'shoreline' as defined within this part. The special management area shall also include the surrounding area extending one hundred yards from the border of any body of surface water subject to salinity intrusion or tidal influences and the waters themselves. However, such areas which abut any island and upon portions of which there are numerous residential, commercial, or other structures of a substantial nature in existence as of the effective date of this bill, are excluded from the management area.<sup>38</sup>

Within these areas, the Shoreline Protection Act instructed counties to require a permit for development.<sup>39</sup>

The SMA is currently regulated by rules, regulations and procedures developed by each county pursuant to the objectives, policies and guidelines of the Act. The regulations do not explicitly prohibit any activity from occurring in the SMA. Instead, the permit process is intended to provide the counties with an opportunity to ensure that proposed developments minimize adverse environmental impacts to coastal resources, protect public recreation and wildlife preserves, and ensure adequate public access to these areas.

#### The Hawaii Coastal Zone Management Act of 1977

In May 1977, the State Legislature adopted Act 188, SLH 1977, thereby establishing a permanent CZM program for Hawaii. Act 188, Hawaii's CZM law, retained some of the interim measures established by the Shoreline Protection Act. The law designated counties as the implementing authorities in the SMA, and made only minor modifications in their responsibilities existing under the Shoreline Protection Act. The rules and regulations of the county permit system applicable to the SMA were left intact. The DPED was also retained as the lead agency, responsible for administering the State's CZM program.

Major changes were made in other areas. Originally reading,

It is the purpose of this chapter to authorize the State Department of Planning and Economic Development to prepare a plan for the management of the State's coastal zones which complies with

the requirements of the Federal Coastal Zone Management Act, and which guides the state and counties in the exercise of their authority in coastal zones;<sup>40</sup>

the intent of the legislation was amended by the addition of the following clause:

Where Hawaii's unique geographical and political circumstances result in the necessity of choosing between the intent of the federal legislation and specific requirements the purpose of this Act shall control;<sup>41</sup>

indicating the Legislature's acknowledgement of county concerns that compliance with federal laws and regulations may not necessarily be consistent with the needs of the State of Hawaii.

The Hawaii CZM Law also established an entirely new set of coastal zone management objectives and policies. In addition, a provision in the act allowed DPED to submit new guidelines for implementation prior to the convening of the 1978 Legislature. Although guidelines were not submitted to the 1978 Legislature, the option to submit them in the future remains available.

Although the State Legislature had an opportunity to define the inland CZM boundary when it enacted the Hawaii CZM law, it left the boundary issue unresolved. Rather than establishing an inland boundary for the Hawaii CZM Program, the law mandates the counties to review and amend their existing SMA boundaries within a two-year period, ending June 8, 1979. The boundaries are to be amended by the counties to be consistent with the objectives, policies, and possible guidelines of the Hawaii CZM law, and will be reviewed by DPED for compliance with the objectives and policies of the law. These amended boundaries will then serve as the inland boundaries for Hawaii's CZM Program.

Disagreements over the delineation of the State's inland boundaries nearly jeopardized the passage of the Hawaii CZM law. Support by State agencies for the designation of the entire State as the coastal zone was viewed by opponents of the proposal as a move by the State to increase its powers and, as such, another threat to traditional county autonomy. The Legislature attempted to resolve these conflicts by adopting compromise provisions. By their failure to act on the boundary issue, however, legislators indicated a reluctance to incorporate the whole state in the coastal zone. Although it is still theoretically possible to use the option of the entire state as the coastal zone,

the Legislature has made it clear that to make such a choice would be neither politically wise nor in keeping with the legislative intent of the Act.

The debate which ensued over the establishment of the inland coastal zone boundaries for Hawaii's CZM program as Act 188, SLH 1977 took shape illustrates the complexity of making such a decision. In addition to the technical problems inherent in determining an inland CZM boundary, political considerations further complicate the decision-making process.

During the early stages of program development, Hawaii's CZM program seemed to be moving in the direction of including the whole state as the coastal management area. In 1975, the first-year summary reports prepared by technical planning consultants to the State arrived at several preliminary conclusions on the boundary issue:

- \* It is not possible to demarcate a "coastal zone" management area in Hawaii that includes all the shorelands, the uses of which have a direct and significant impact on coastal waters without including all or most of the state.
- \* It is difficult to designate a "coastal zone" management area in Hawaii that is sufficient to achieve all or most of the management purposes without including all or most of the state.
- \* The problems of Hawaii's coastal zone might be better addressed through problem-specific, geographic-specific, or resource-specific management than through the designation of a single coastal zone of uniform or variable distance from the shorelines.<sup>42</sup>

The State's consultants based their conclusions on their analyses of the problems involved in establishing technical criteria based on Hawaii's natural resource systems to meet the requirements of the federal legislation. One of the basic problems in defining the coastal zone is to identify that part of a natural continuum needing special management attention.<sup>43</sup> Although the minimum requirement set by the federal CZMA that a state's coastal zone must include "transitional and intertidal areas, salt marshes, wetlands, and beaches"<sup>44</sup> is straightforward, a scientific demarcation of such areas could prove to be difficult. The extent to which ocean salt of various concentrations penetrates estuaries depends not only upon basin geometry and

tides, but also upon highly variable stream flows. Inland ponds of West Hawaii and Maui, some of which are quite removed from the shorelines, are equally affected by various degrees of salt penetration and tidal flux. The dual concepts of "strongly influenced by each other" and "direct and significant impact upon the coastal waters",<sup>45</sup> also set by the CZMA, are of little help in conceptualizing and demarcating an inland boundary in Hawaii where almost one-half of the total land area lies within five miles of the coast, and where there is no point more than 29 miles away from the sea. The waters of a flash flood in the Kaneohe Bay region, for example, take less than an hour to descend from the top of the pali (or mountain cliffs) to the bay. Pollutants added to the soil, and the soil itself, ultimately reach the ocean via a variety of pathways that are difficult to specify in a way which provides a bio-physical rationale for defining an inland CZM boundary. In addition, Hawaii's major drainage basins are so close to the sea that it is virtually impossible to claim that what happens on one side of an artificial boundary has a direct and significant impact on coastal waters, and what happens on the other side does not. The only lands that could be excluded from the coastal zone under the criterion for direct and significant impact would be those lands that are mountainous or highly irregular, and therefore, of undevelopable character.

In analyzing these types of boundary issues, the consultants focused on the range of coastal problems affecting Hawaii. Each coastal zone problem occurring in Hawaii was examined in terms of the management purposes for dealing with that problem. Nine management purposes were identified:

- 1) Conservation of coastal water ecosystems;
- 2) Management of waste water;
- 3) Conservation of coastal terrestrial ecosystems;
- 4) Conservation of sand resources;
- 5) Storm wave and tsunami hazard reduction;
- 6) Enhancement of coastal recreational opportunities;
- 7) Preservation of historic and cultural resources;
- 8) Preservation of scenic and aesthetic resources;  
and

- 9) Identification of land and water areas having high potential for meeting particular societal requirements.<sup>46</sup>

The choice to make for those involved with the development of Hawaii's CZM program lay between a coastal zone area that was broadly defined to include all or most all of the State and an area that was narrowly defined to include only a narrow shoreline strip. The advantages and disadvantages of these two extremes were debated.

The advantages involved in defining the coastal zone as a narrow area revolved around state and county abilities to direct resources to problems specific to coastal areas. Delineating a narrow coastal zone would allow a concentration of Federal and State coastal zone planning and management funds in the State's most vulnerable coastal zone areas. It would also permit the development of county or State-administered regulatory programs focused specifically on coastal zone management problems.

Disadvantages inherent in adopting a narrowly-defined coastal zone included the potential difficulties involved in defining the area in operational and political terms in view of the consultants' first-year technical reports, and conceptually justifying the area in terms of the nine management purposes identified by the consultants. This definition would also arbitrarily exclude many areas or activities of coastal significance from the coastal zone boundary. Finally, the definition would constrain the State from using coastal zone planning and management funds anywhere in the State where problems having a coastal impact arise.

The advantages of designating the entire state as the coastal zone included the ability to integrate the administration of the State's CZM program with other related statewide planning efforts, such as the Section 208 wastewater treatment planning program. It also would enable other State and County monies available for planning programs to be supplemented by CZM planning and management funds anywhere in the State. In addition, it would allow the State to demand Federal consistency with the CZM program on a statewide basis, thus making all Federal activities in the State to be subject to the objectives, policies and guidelines of Hawaii's CZM program. Finally, the whole-state definition of the coastal zone enabled all activities generating impacts on the coastal lands and waters to be addressed.

The designation of the entire state as the coastal zone posed potential problems in integrating the upcoming State General Plan with the CZM program, since each program would apply, geographically, to most of the State. Another disadvantage seen in the designation



was that the adoption of certain regulatory controls through the CZM program such as a permit system, would preempt other regulatory land and development controls exercised by the State and counties.

Following deliberations of the administrative, as well as technical issues involved, a boundary proposal was developed. It identified the whole state as the coastal zone, to be managed in conjunction with the concept of Areas of Particular Concern (APC).

The APC concept involves placing, under special management treatment, those specific geographic areas with which important values are associated, which are under immediate threat or pressure, and/or are inadequately managed. As an APC, a specific area can be managed under special tools and techniques different from those employed in other areas. This arrangement was devised in order to provide additional flexibility in dealing with coastal zone concerns, while at the same time maintaining the State's eligibility for the application of CZM planning and funding.

The initial proposal reflects the position taken by the DPED during the first year of program development in 1976. However, all of the county governments as well as large landowners and developers were opposed to designating the whole state as the coastal zone. County spokesmen objected to the potential encroachment by the State on areas of county authority, and maintained that the proposal would have a preemptive effect on all county planning activities. They also held that the state's coastal areas were being adequately managed under county regulations and questioned the necessity of imposing additional management controls.

After recognizing that county opposition could jeopardize the entire CZM program in Hawaii, the State's consultants developed a compromise proposal. It was recommended that a two-tiered approach be taken with respect to the boundary issue. The Special Management Area, as identified and administered by the county governments under the Shoreline Protection Act of 1975, was designated as the first tier. The objectives, policies and guidelines of the Hawaii CZM program would be binding on Federal, State and county agencies within this tier. The second tier included the rest of the State. This designation was to be used primarily for planning and administrative purposes and for Federal-State consistency purposes in that the objectives, policies, and guidelines of the CZM program were to be binding on Federal and State agencies only within respective areas of jurisdiction. In addition, the APC concept was to be applied throughout the State in response to problems of statewide significance.

This was the proposal that was presented to the State Legislature during its 1977 session. Although DPED maintained that this proposal answered some of the earlier objections, the counties disagreed, and remained opposed to the CZM plan. It was left to the State Legislature to act upon the issue.

The original intent of DPED, in submitting CZM legislation during the 1977 legislative session, was to provide the State with the required controlling mechanisms to gain federal program approval. However, lack of consensus among citizens, the four county planning directors, and DPED caused the original bill, initially drafted by DPED, to be drastically altered. What emerged was a last-minute compromise bill which left the coastal boundary issue unresolved.

#### THE CURRENT STATUS OF HAWAII'S CZM PROGRAM

Hawaii is now in its fourth year of CZM program development, and is in the process of preparing its submission document in conjunction with its application for federal program approval. At this time, permanent inland boundaries of the State's coastal zone have not been adopted. Under the Hawaii CZM law, amendments to existing SMA boundaries made by the counties and approved by DPED will be adopted as the State's permanent inland coastal boundaries. This task has yet to be accomplished.

During the interim period in which the SMA boundaries are being amended, an Administrative Coastal Zone Management (ACZM) area has been declared by the State. This area, established for planning and administrative purposes, will remain in effect until permanent inland boundaries have been approved and adopted for Hawaii. The ACZM area includes all coastal waters seaward to the limit of the State's jurisdiction, all land areas included within the existing SMA boundaries, and all remaining inland areas, excluding those lands designated as State forest reserves.<sup>47</sup>

The ACZM boundary was established for the interim period for several reasons. First, the boundary provides coastal areas with interim protective measures against detrimental impacts potentially resulting from activities occurring in lands lying outside existing SMA boundaries. Second, declaration of the ACZM boundary subjects all lands within the area to the requirements of Hawaii's CZM program. This frees the State and counties to channel monies for CZM activities to all areas in the Islands. Third, the establishment of the ACZM enhances coordination among the CZM activities undertaken by the State, county, and federal agencies, thereby supporting the intent of the

newly-enacted Hawaii State Plan.<sup>48</sup> Lastly, it ensures the consistency of federal actions with Hawaii's CZM program.

As a prerequisite for obtaining federal program approval, the federal CZMA requires states to inventory and designate Areas of Particular Concern (APC) within their coastal zones, and to demonstrate the ability to manage these areas. In conjunction with its declaration of the ACZM area, the State has cited five existing state programs as evidence of the APC mechanism in Hawaii. These programs, the Natural Area Reserves System,<sup>49</sup> Marine Life Conservation Districts Program,<sup>50</sup> Estuarine Sanctuaries Program,<sup>51</sup> Shoreline Setback Law,<sup>52</sup> and Hawaii Community Development Authority,<sup>53</sup> are considered to be analogous to, and in keeping with the requirements of the APC concept.

The declaration of the ACZM boundary subjects all lands in this area to the requirements of the Hawaii CZM law. However, the law's provisions for enforceability, which fall under its cause of action clause,<sup>54</sup> are in effect applicable only within the boundaries of the existing county SMA's and the State's waters. In order to ensure that the elements of the Hawaii CZM program are addressed by State agencies operating in the entire CZM area, including the ACZM area, the Governor of Hawaii issued Administrative Directive 78-3. This directive, issued on July 24, 1978, requires all State agencies to comply with the objectives and policies of the Hawaii CZM Program, thereby ensuring consistency with respect to Hawaii's CZM law among the activities undertaken by State agencies.

It is now left for the counties to make their amendments to the existing SMA boundaries, a task that will not be easily accomplished. Although the 100-yard minimum requirement for the SMA boundary remains, the old boundaries adopted by the counties under the Shoreline Protection Act must undergo substantial revision in order to comply with the objectives and policies of the Hawaii CZM law for reasons which include:

- 1) The objectives and policies of the Hawaii CZM law are more explicit and include additional elements not contained in the Shoreline Protection Act;
- 2) The boundaries established under the Shoreline Protection Act are not subject to State review for compliance, as will be the new boundaries established under the Hawaii CZM law; and
- 3) The original boundaries may have been drawn in haste, due to legislative deadlines, and may only superficially address some requirements.

For these reasons, the new boundaries will require careful consideration prior to their designation. It is likely that boundaries will have to be extended inland in many areas. In others, boundaries may be maintained, or even decreased.

The DPED is responsible for developing criteria with which to evaluate the boundary amendments made by the counties. This is another element required as part of its preparation of the state's submission document to the federal program. The criteria are intended to provide definitions of the permanent CZM areas sufficient to meet the requirements set by the federal CZM legislation.

Establishment of boundary criteria applicable to the entire state, in itself, involves the consideration of a number of complex issues. Since the requirements of the law apply to all of the counties, the criteria for reviewing the boundaries must do the same. Yet, the criteria cannot determine the optimal boundary for all counties because of inherent differences among them. Each county has a unique set of problems and concerns with which it must deal. Although similarities exist, the emphasis given and resources allocated to solving problems by each county will vary among them.

An illustration of these differences lies in county concerns regarding scenic and open space resources. By the differences in degrees of intrusion on open space experienced between them, one would expect residents of Oahu to be more concerned about scenic and open space resources than residents of Hawaii County. Therefore, the emphasis placed on the scenic and open space element of the boundary criteria by each of the two counties should reflect the differences in concerns. The optimal criteria for Oahu may not be the same for Hawaii County and vice versa.

An analysis of the requirements of the Hawaii CZM law yields the elements which must be considered for boundary determination purposes: recreation, scenic and open space resources, coastal ecosystems, hazards, and economic uses. By virtue of the requirements contained within Hawaii's CZM law, several elements will have to be included which cannot be identified solely through the use of natural resources, natural features or natural processes criteria. For example, criteria based on economic uses must depend heavily on existing zoning, general plan, or community development plan designations because that is the only means by which to meet the requirements of the law. In addition, the law requires that stream flooding hazard areas be included within the CZM boundary in spite of doubts concerning their relationship with coastal areas. These are examples of requirements which force Hawaii to utilize existing political or cultural boundaries and features for boundary designation purposes. These limitations must be kept

in mind when reviewing the recommended criteria, their guidelines, and their applications. Although the criteria attempt to be oriented toward natural resources, certain requirements preclude a pure approach to the task.

The objectives and policies of the Hawaii CZM law also complicate the determination of the boundary criteria. A major difficulty encountered in interpreting the law is the lack of consistency between its objectives and policies. The objective for scenic and open space resources, for example, reads as follows:

Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources. (emphasis added)

One of the policies for scenic and open space resources, however, reads as follows:

Preserve, maintain, and where desirable, improve and restore shoreline open space and scenic resources. (emphasis added)

There is a significant difference between the words "coastal" and "shoreline". The implication for inland boundary determination purposes would be quite narrow if "shoreline" was used as the basis for interpreting the scenic and open space element of the law. On the other hand, it would probably be much broader if the term, "coastal" were used.

The need to accomodate these kinds of conflicts has led to the development of minimum boundary criteria. The least common denominator among the counties is the need to meet the requirements of the Hawaii CZM law. Approval or disapproval of any amended boundary, therefore, should be based only on the minimum criteria implied by the law. Determination of the minimum boundary criteria thus provides the counties and DPED, which must review and certify the county-amended SMA boundaries, with a base from which to start. In addition, it provides the counties with increased flexibility in making their boundary delineation decisions, freeing each county to go beyond the minimum requirements if it chooses to do so.<sup>55</sup>

The approach currently being taken in delineating Hawaii's inland coastal boundaries balances political and legal limitations with natural resource requirements. This is not unlike the approaches being taken by other coastal states. A review of the CZM programs of other states reveals a wide variety of options taken in delineating a CZM boundary. It is interesting to note that in spite of the fact

that the CZM program is a natural resource management program, and that the majority of the federal boundary requirements are resource-oriented, only a handful of states depend heavily on natural features, natural resources, or natural processes for determining their inland boundaries. Not surprisingly, existing political and cultural boundaries or features are used most often as the basis of coastal zone boundaries. This option is the easiest to implement in that the boundaries already exist, are well-defined, and are easily recognized.

Based on these observations, one could conclude that while a boundary based on natural features, natural resources, or natural processes may be an ideal, it is not easily achieved. Many states have apparently decided that the cost of developing their CZM boundaries based on these considerations is too high and have opted for more expedient alternatives. Other factors could have also restricted the alternatives available to the states. Hawaii certainly demonstrates how a state must attempt to balance the federal requirements with additional restrictions created by a state law.

#### PURPOSE AND ORGANIZATION OF THIS REPORT

In light of the range of considerations which complicate the task, this paper was undertaken in order to provide DPED with a technical foundation upon which to establish the criteria for determining the state's inland CZM boundaries.

This section was intended to provide readers with a historical perspective of both the development of the federal and Hawaii state CZM programs and the evolution of the inland boundary issue. Section Two will provide a review of various methods for determining inland boundaries. It includes a discussion of general approaches and a summary of approaches taken by other states with respect to the boundary issue. Section Three presents three alternatives for interpreting federal and state boundary requirements. Section Four identifies the recommended minimum inland boundary criteria for Hawaii's CZM Program. Section Five identifies general guidelines for implementing the criteria developed in Section Four. Finally, Section Six presents an application of the criteria developed in the paper to a specific geographic area, in this case, the Kaneohe Bay region.







## SECTION II

### A NATIONAL PERSPECTIVE

Thirty-four coastal states and territories<sup>1</sup> are developing management programs under the national Coastal Zone Management Act of 1972. Each of these states and territories have had, or are continuing to grapple with the problems and issues associated with identifying an inland boundary for the coastal zone. Although a few states already have approved boundaries, most program participants are still in the process of finalizing their coastal zones.

This section briefly surveys the various approaches coastal states and territories have taken to define their program boundaries. The discussion of individual state boundaries, for reasons stated above, should be taken as time-bound proposals and/or alternatives. For, it is anticipated that many states and territories will be modifying their proposed boundaries to accommodate the views of legislative bodies, administrative agencies, the public, and OCZM.<sup>2</sup>

#### Federal Requirements

The National Oceanic and Atmospheric Administration's (NOAA) regulations for development and approval of state coastal management programs provide a context for understanding how other state programs have evolved. The most recent regulations were printed in the Federal Register on March 1, 1978.<sup>3</sup> The regulations which pertain to the inland boundaries provide a common basis by which the various boundary development options may be understood. Sub-section 923.31 elaborates on the statutory requirements for identifying the inland boundaries of the coastal zone. The following passages are most appropriate.

- (a) Requirement. The inland boundary of a State's coastal area must include:
  - (1) Those areas the management of which is necessary now or is likely to be necessary in the near future to control uses which have a direct and significant impact on coastal waters, pursuant to section 923.11 of these regulations (uses subject to management);
  - (2) Those special management areas identified pursuant to section 923.21 (areas of parti-

cular concern);

- (3) Transitional and intertidal areas - Areas subject to periodic or occasional inundation by tides, as, for example, coastal flood plains, storm surge areas, tsunami and hurricane zones, or washover channels;
- (4) Salt marshes and wetlands - Areas subject to regular inundation of tidal salt (or Great Lakes) waters which contain marsh flora typical of the region;
- (5) Islands - Bodies of land surrounded by bodies of water on all sides. In the case of Puerto Rico, the U.S. Virgin Islands, Hawaii, Guam, American Samoa and the Northern Marianas interior portions of the major island(s) may be excluded if uses of these lands do not cause direct and significant impacts on coastal waters;
- (6) Beaches - The area affected by wave action directly from the sea. Examples are sandy beaches and rocky areas usually to a vegetation line.

And,

- (e) Requirement. The inland boundary must be described in a manner which is sufficiently clear and exact to enable persons to determine whether property they use or an activity they propose to undertake is or is not located in the area subject to management. Whether this description should be in narrative form or graphically depicted in the management program document depends on (i) the nature of the boundary and (ii) whether it is possible to determine if a use or an area is within the coastal zone within a reasonable period of time. 'Reasonable period of time' means that States must be able to advise interested parties whether they are subject to the terms of the management program within, at a maximum, 30 days of receipt of any inquiry. States should endeavor

to respond to inquiries within a shorter time period in order not to cause unnecessary uncertainty for affected parties.<sup>4</sup>

Further discussion of the federal requirements on the inland boundaries is provided by a "white paper" prepared by the Office of Coastal Zone Management.<sup>5</sup> The paper identifies approvable approaches, subject to negotiation, for meeting the requirements of the regulations. The approaches include:

- (1) Biophysical: A biophysical boundary is defined by natural features, biological, geological and/or physical. These features may include drainage basins, floodplains, dune formations, ecosystems, ridges of coastal mountain ranges, etc.;
- (2) Administrative: An administrative boundary can be delimited by political boundaries (county, township, municipal lines, SMAs, etc.); cultural features (highways, roads, canals, etc.); or existing planning areas (census enumeration districts, etc.) This boundary must still approximate the biophysical processes;
- (3) Uniform: Some states have proposed a strip of uniform width as a coastal zone. Because of a lack of obvious relation to either the impact or control aspect, this approach will be acceptable only if:
  - (a) The state can show that the uniform zone does reasonably approximate the biophysical determination of impacts; or
  - (b) The uniform strip applies to an area in which biophysical determination of impacts is impractical; such areas may include urban regions or altered waterfronts (see 5 below); or
  - (c) The strip is a primary control zone supplemented by a broader multiple boundary (see 4 below);
- (4) Multiple: A multiple boundary consists of a number of boundaries delineating areas in which different

sets of controls will be implemented. There are two primary reasons to use such a multiple scheme. First, existing legislation may have jurisdiction over all coastal areas with different boundaries. Second, uses may have direct and significant impacts in one area but not in another; a multiple boundary approach could provide for control of different uses, or different controls on the same use, in the distinct areas; and,

- (5) Urban or Greatly Altered Areas: One intent of the Act is to prevent undue disruption to natural coastal ecosystems involving both land and water areas. In many coastal areas, whether urbanized or otherwise extensively modified, natural systems relationships between land and water may be unduly complex and difficult, if not impossible, to define, or of relatively small importance. In these areas, the state may define inland boundaries on the basis of other factors relating to the strong influence of the waters upon the land; including, but not limited to, dependency of use upon water sites or visual relationships.<sup>6</sup>

#### Program Management and Boundary Schemes

Descriptions of the proposed or established boundaries for thirty-three of the coastal states and territories participating in the CZM program were obtained from program managers.<sup>7</sup> A review of descriptions indicates that all of the participating states and territories are using one, or a combination of the following boundary development options to delineate their CZM boundary:

- (1) Fixed linear distance inland from the shoreline
- (2) Political/cultural boundaries (municipal boundaries, county boundaries, census tract boundaries, property lines, flood hazard boundaries, etc.)
- (3) Elevation (five foot, ten foot contours, etc.)
- (4) Natural features/natural resources (mountain range, headwaters, sand dunes, rivers); and

- (5) natural processes (relationships between land and water ecosystem).

While reviewing the above approaches which states and territories have used in the determination of inland boundaries, it became evident that any further discussion should first consider a state's proposed management controls. States were given considerable flexibility in determining the degree and type of management controls to be used in achieving coastal policy. As such, there has been some variation in the management mechanisms developed. These management controls have a significant bearing on the determination of boundaries. For example, states utilizing an extensive management control such as a permit system might want to limit the area in which the permit applies in order to minimize the administrative expense to the agency as well as the additional burden such a permit places on a developer. For states utilizing general planning controls to achieve coastal policies, broader areas may be needed so as to insure the inclusion of inland activities and areas affecting the coast. In each of these schemes, the minimal requirement is to ensure that activities which may have a significant impact on valuable coastal resources are included and that like parcels of land are treated similarly.

There are several management control schemes which are being developed by coastal states. These basically include the use of a "permit" option, a "planning area" option, or some combination of the two, depending on the number of boundaries defined in state's management plan. All of the boundary development techniques are influenced by these management schemes and vice versa.

Increasing the number of boundary tiers complicates the management system, but, it also provides states with greater versatility in management control. Simply stated a state has a wide variety of boundary delineation techniques/management strategy choices. These choices are clearly reflected in the divergent paths chosen by the coastal states to achieve the objectives of the Coastal Zone Management Program. These alternative schemes will be described in the following pages.

The term "boundary tiers" refers to divisions within a state's Coastal Zone Management area. These divisions demarcate changes in management techniques, jurisdictional responsibility, or program emphasis. Participating states and territories utilize a range of one to three boundary tiers. A single-tiered program has no divisions within its Coastal Zone Management area and only one inland boundary. The management technique, jurisdictional responsibility and program emphasis are uniformly employed throughout the coastal zone. A two-tiered program has two inland boundaries in which jurisdictional responsibility

program emphasis and management control vary. Generally, this means an intensive zone with a narrow boundary called the first tier, and, a broader second tier for more general management. The three-tiered option is used by only two states and will be discussed in greater detail below. Table 2.1 (next page) provides a breakdown for the number of boundary tiers being used by states and territories.

The "planning area" option serves to delineate an area of focus where state and local governmental activities may be planned and directed in a consistent and coordinated fashion. However, permit intensive controls are absent from this area. The boundary delineates areas where CZM financial and technical assistance will be available to address coastal concerns and where Federal compliance with the management program can be assured. States utilizing the planning area option (not in combination with the permit option) will manage the coastal zone area without creating a new coastal zone permit authority. These states will utilize their existing management authorities to accomplish their coastal management objectives. Table 2.2 identifies state approaches to the designation of planning areas in terms of the boundary development options discussed previously.

The use of a permit option is usually dependent on a state's existing network of laws and regulations controlling land and water activities which may impact on coastal waters. That is, as determined by the OCZM, some states already have the required organization and legal powers to carry out a coastal zone management program. Other states may need to develop new statutes or add to existing statutes or ordinances in order to strengthen (or create) their management systems. One way that this may be accomplished is through the creation of a new regulatory mechanism such as a coastal zone permit specifically designed to handle coastal concerns. The permit option has been used by some states needing extra coastal control. Table 2.3 identifies approaches states have used in designating permit areas. The table also identifies those states that have used the multi-tiered option, separating planning and permit areas. A handful of states use a combination planning/permit option in a single tier. State approaches to the designation of the permit and planning boundary combined are presented in Table 2.4.

New Hampshire and Puerto Rico are the only two participants using a three-tiered boundary concept. These two cases will be discussed in greater detail because they provide good examples for understanding the concept of tiers.

New Hampshire had divided its coastal zone into three subzones to distinguish between the following:

- (a) a primary zone where almost any land or water use could have a direct and significant impact on coastal waters;
- (b) a secondary zone where many uses could have a direct and significant impact on coastal water quality;
- (c) a tertiary zone where only a few uses or changes would have a direct and significant impact on coastal waters. (Office of Comprehensive Planning, State of New Hampshire)

The primary zone is determined either by elevation (the first 20' contour) or a fixed linear distance (1,000') whichever is furthest inland. The secondary zone is determined by existing political/cultural boundaries extending to the non-primary zone portions of the municipalities which have areas designated as part of the primary zone. The tertiary zone is determined by considerations of natural features and existing political/cultural boundaries.

Puerto Rico, unlike New Hampshire, does not require a permit in the third tier of its management boundary. The first tier is determined by a fixed linear distance (1 kilometer) from the shoreline. This will be the zone of primary management focus. The second tier is being considered as a review area, with emphasis on the review for permissible uses. The third tier, representing the overall planning area, will be determined by a fixed linear distance (7 kilometers) which closely approximates municipal boundaries.

Six states and participating territories (for which information was available) have not completed a total package of a boundary development option and a management scheme. Guam has decided to declare the whole island as its coastal zone, but those developing the program have not recommended a management scheme as yet. Alaska and Georgia will determine their boundaries based on natural processes and natural features but have not decided on a management scheme as well. Ohio will use a combination of boundary development options including existing political/cultural boundaries and natural features. Alaska, Georgia, Guam and Ohio have not yet determined a management scheme. Two states, Indiana and Minnesota, have not determined either a boundary development or management option at this time.

Table 2.1

STATE APPROACHES TO THE NUMBER OF BOUNDARY TIERS, COASTAL  
ZONE MANAGEMENT PROGRAMS

States	Number of Tiers, Purpose			
	Single Tier	Two Tiers	Three Tiers	Undetermined
Alabama	for planning			
Alaska				X
California		one for permit and one for planning		
Connecticut		two permit bound- aries		
Delaware		one for permit and one for planning		
Florida		two planning bound- aries		
Georgia				X
Guam	no determination of management option (entire island)			
Hawaii	for permit and planning			
Illinois	for permit and planning			
Indiana				no management or boundary option yet
Louisiana	for permit and planning			
Maine		two for permit		
Massachusetts	for planning			
Michigan		two for permit		
Minnesota				no management or boundary option yet
Mississippi	for permit and planning			
		(continued)		



Table 2.1 concluded  
STATE APPROACHES TO THE NUMBER OF BOUNDARY TIERS, COASTAL  
ZONE MANAGEMENT PROGRAMS

States	Number of Tiers , Purpose					
	Single Tier	Two Tiers	Three Tiers	Undetermined		
New Hampshire	for permit and planning	one for permit and one for planning	three for permit	X		
New Jersey						
New York						
North Carolina						
Ohio	for planning	one for permit and one for planning	two permit boundaries and one for planning			
Oregon						
Pennsylvania	for planning					
Puerto Rico						
Rhode Island	for permit and planning	one for permit and one for planning				
South Carolina						
Texas	for planning	one for permit and one for planning				
Virgin Islands						
Virginia		one for permit and one for planning				
Washington		one for permit and one for planning				
Wisconsin	for planning					

Source: Presented information reflects material supplied by states and territories participating in CZM programs or material available in program progress reports prepared by the Federal Office of Coastal Zone Management.

Table 2.2

STATE APPROACHES TO THE DESIGNATION OF PLANNING AREAS,  
COASTAL ZONE MANAGEMENT PROGRAMS

States	Boundary Development Option				
	Fixed Linear Distance	Political/Cultural	Elevation	Natural Features/ Natural Resources	Natural Processes
Alabama	five miles inland from high tide level	entire state census enumeration district which closely approximates the extent of selected physical characteristics	ten foot contour	highest elevation of coastal mountain range	
California					
Delaware					
Florida					
Maine					
Massachusetts					
New Jersey					
North Carolina					
Oregon					
Pennsylvania					
Puerto Rico	7 kilometers (closely approximates municipal boundaries)	property lines, vacant land, highways and railway lines		crest of coastal mountain range	

Table 2.2, concluded

STATE APPROACHES TO THE DESIGNATION OF PLANNING AREAS,  
COASTAL ZONE MANAGEMENT PROGRAMS

States	Boundary Development Option				
	Fixed Linear Distance	Political/Cultural	Elevation	Natural Features/ Natural Resources	Natural Processes
South Carolina		all coastal counties			contiguous coastal water and shoreland environments which are interdependent
Texas					
Virgin Islands		entire island			
Virginia		all coastal counties			
Washington		all coastal counties			
Wisconsin		all coastal counties			

Source: Presented information reflects material supplied by states and territories participating in CZM programs or material available in program progress reports prepared by the Federal Office of Coastal Zone Management

Table 2.3

STATE APPROACHES TO THE DESIGNATION OF PERMIT AREAS,  
COASTAL ZONE MANAGEMENT PROGRAMS

States	Boundary Development Option				
	Fixed Linear Distance	Political/Cultural	Elevation	Natural Features/ Natural Resources	Natural Processes
California	1,000' inland from the shoreline				
Connecticut	1,000' inland from the shoreline	100-year coastal flood line (determined by HUD Flood Insurance Program)			
Delaware		roads which approximate the 10' elevation contour			
Maryland		all coastal counties 100-year flood plains bordering tidal waters			
Michigan		town or municipal boundaries, arterial roads			
New Hampshire	1,000' inland from the shoreline	municipal boundaries	the first 20' contour inland from the shoreline		
New Jersey		flood plains		selected watersheds, upper wetland boundary, mean high tide line	hydrologic systems draining to coastal waters
North Carolina		hazard areas, public trust or public access areas		coastal wetlands and estuarine waters, significant resource areas	
Puerto Rico	1 kilometer from the shoreline	circumferential highway			
		(continued)			

Table 2.3, concluded  
STATE APPROACHES TO THE DESIGNATION OF PERMIT AREAS,  
COASTAL ZONE MANAGEMENT PROGRAMS

States	Boundary Development Option				
	Fixed Linear Distance	Political/Cultural	Elevation	Natural Features/ Natural Resources	Natural Processes
South Carolina				all submerged lands, sand dunes, beaches, and tide-lands	waters containing measurable quantities of seawater
Virgin Islands	uniform distances	roadways, landmarks and property lines	contour lines		
Virginia (a)					
Washington	200' inland from the shoreline			all coastal wet-land areas	upstream limit of salt water intrusion for estuarine areas

(a) Virginia has yet to specify the boundary option which will be used to define the permit area.

Source: Presented information reflects material supplied by states and territories participating in CZM programs or material available in program progress reports prepared by the Federal Office of Coastal Zone Management.

Table 2.4

STATE APPROACHES TO THE DESIGNATION OF PERMIT AND  
PLANNING BOUNDARY COMBINED, COASTAL ZONE MANAGEMENT PROGRAMS

States	Boundary Development Option				
	Fixed Linear Distance	Political/Cultural	Elevation	Natural Features/ Natural Resources	Natural Processes
Hawaii (a)	100 yard minimum inland from the shoreline	stream flooding and tsunami inundation areas subject to the requirements of the National Flood Insurance Act		high quality streams and estuaries, anchialine pools, brackish water lakes, turtle nesting beaches, and geologic and physiographic features of marine origin	areas vital to the life support of threatened or endangered species, wetlands which function as buffers
Illinois		property lines, transportation rights-of-way, 100-year lake flood plain or erosion hazard area			
Louisiana		range, township, parish, or railroad line that most closely approximates the 5' contour line		headwaters of Atchafalya Basin	
Mississippi		all counties directly adjacent to the Gulf coast			
New York		utility lines, highways, town boundaries			
Rhode Island		inland census tract greater than the 1 miles minimum (generally, all municipalities bordering the shoreline)			

(a) Information for the State of Hawaii was obtained from Chapter 205A, HRS (100 yard minimum) and Table 1 (p. 62) of the Final CZM Program EIS, State of Hawaii.

Source: Presented information reflects material supplied by states and territories participating in CZM programs or material available in program progress reports prepared by the Federal Office of Coastal Zone Management.

## Analysis of the Boundary Options

All of the boundary development options which were previously identified will be discussed below. While all of them have some positive characteristics to offer, their usefulness will have to be determined by weighing their negative consequences as well.

### Fixed Linear Distances

Nine states and territories are using the fixed linear distance boundary option to delineate a first tier or single tier. In this area permit controls are emphasized as the predominant form of management control.<sup>8</sup> Two of these states are also using the fixed linear distance boundary option to delineate a planning boundary.<sup>9</sup>

The advantage of a fixed linear distance for either permit or planning purposes is that it provides uniform coverage throughout the coast. All areas equidistant from the shoreline are treated similarly. No other boundary option can provide this feature. While this option provides a convenient easy to map area and avoids the legal problem of treating like land parcels similarly, there are many disadvantages. First, a fixed linear distance is an arbitrary choice without any correspondence to the objectives and policies of the CZM program. In certain areas the distance selected may be too narrow to encompass some "shorelands, the uses of which have a direct and significant impact on coastal waters." (CZM Act of 1972, Sec. 304(1)(C)) In other areas the distance selected may be too broad; for example, highly developed and intensely urbanized locations may be inappropriate for CZM regulation because past decisions have already determined the character and use of these areas. In other words, the major criticism of the fixed linear distance boundary is that it fails to account for the management purposes of the federal act. In particular, ecological considerations are not adequately addressed.

### Political/Cultural Boundaries

Twelve states and territories are using existing political/cultural boundaries to delineate a CZM boundary tier for permit purposes.<sup>10</sup> In addition, twelve states are using the political/cultural boundary option to delineate a boundary for planning purposes.<sup>11</sup> This boundary option has several advantages which make it attractive to many of the participating agencies. The major advantage is that these boundaries are already existing, are well defined, and easily identified for both planning and regulatory purposes. For administrative purposes, this type of boundary is

easier to deal with because the management area is contained within a single jurisdiction; that is, the management plan and permit procedure can be applied consistently throughout the jurisdiction.

While expediency and efficiency are valuable attributes, several disadvantages mitigate some of the desirable qualities of the political/cultural boundary option. In some areas the CZM boundary may provide irregular coverage for land areas located equidistant from coastal waters without any justification based on resource management considerations. This may result in inequitable treatment of similar development proposals; possibly creating legal problems for managing authority. Another disadvantage may be the political infeasibility of this boundary option. In those cases where the boundary is quite extensive due to the nature of the political boundary selected, inland communities that do not consider themselves to be coastal may be included. These communities would more than likely oppose the boundary proposal. Similar to the fixed linear distance option, the political/cultural boundary may include areas inappropriate for coastal zone management. In other words, a boundary based on this option may extend beyond the area necessary to control uses which may have a direct and significant impact on coastal waters.

### Elevation

Elevation, determined by a continuous contour, is used by three states as one of their boundary development options. Louisiana and New Hampshire use elevation to help delineate their boundary for permit purposes. On the other hand, Alabama uses this boundary development alternative to delineate an area for planning considerations. When used in combination with other considerations, various physical and biological factors, for example, an elevation contour may be selected which closely corresponds to the inland extent of coastal concerns. More specifically, the elevation contour can be selected to reflect the need to include an area sufficient to manage those uses which directly and significantly affect coastal waters. Contour lines are already mapped on U.S. Geological Survey Topographic Maps which are widely used by many organizations.

Using elevation as the boundary criterion may have many disadvantages if used arbitrarily without supplementary information to guide the selection of a particular elevation. A boundary selected on this basis may be vulnerable to the argument that it is not based on any resource management consideration. In addition, any boundary selected by this method runs the risk of excluding valuable resource areas or including inland areas which may only have minimal or at best a tenuous relationship to coastal waters. For example, aesthe-



tically valuable coastal scenic resources composed of land features extending to high elevations, such as high scenic rocky points, headlands and sea cliffs may be excluded using such a boundary. On the other hand, political problems can result if inland communities included within the elevation boundary do not consider themselves to be coastal.

#### Natural Features/Natural Resources Areas

A number of states are using natural features/natural resource areas as one of their boundary development options. Washington, Hawaii, New Hampshire, South Carolina, North Carolina, Delaware, and Michigan use this option for delineating permit areas. New Jersey, the Virgin Islands, California, Oregon, and Florida all use it to delineate their planning boundaries. Alaska, Georgia, Guam and Ohio indicate that they will use natural features/natural resources to delineate boundaries without specifying the management scheme to be employed.

The use of natural features/natural resource areas as a boundary development option provides a good opportunity to tailor the boundary to meet the requirements established by NOAA. This is because many of the minimum requirements are described by natural features/natural resource areas (e.g., beaches, salt marshes, wetlands). Another advantage is that natural features are easily recognizable in the field; this makes it easier for property owners and other coastal resource users to understand the geographic scope of the management program. Difficulties may arise, however, if the geographic features selected for boundary determination purposes do not correspond to the requirements identified in the regulations. Additionally, inland areas with little or no coastal relationships may be included within such a boundary.

#### Natural Processes

Several states are using natural processes to help determine their inland boundaries. Washington and Hawaii are the only states using this option to delineate a permit area. Texas, Massachusetts, and Oregon use natural processes to help determine their planning boundaries. Although they have not developed a management scheme, Alaska and Georgia both indicate a desire to consider natural processes as a boundary determinant.<sup>12</sup>

This option probably provides the best opportunity for meeting the inland boundary requirements without unnecessarily including

inland areas which are inappropriate for coastal zone management. This option is based on the premise that charting sustaining flows between ecosystems provides a biophysical procedure for determining land areas where activities may have a direct and a significant effect on coastal waters. The use of natural processes also avoids the potential charge of arbitrariness which seem to plague all of the other alternatives. While potentially the best option, developing a boundary based on natural processes involves the most work and is probably the most difficult to do. In addition, it probably presents the most difficulties for the implementing agency trying to assist the public in understanding the geographic scope of the management program.

### Summary

A review of the data presented in this section indicates that many of the participating states and territories will be using boundary development options which have little or no apparent connection to some of the natural resource management requirements of the Federal Coastal Zone Management Act.<sup>13</sup> That this is a strong possibility is evidenced by the number of states and territories using the fixed linear distance, political/cultural boundaries, or elevation as boundary development options.

In terms of time and money, the three options discussed above are probably the least expensive for the states and territories to implement. These options may be used to approximate those areas which meet the description of the federal boundary requirements. The use of approximation is based on a number of zoning decisions which state the principal that, "when the exact location of a boundary is fairly debatable, within certain limits, that since the 'line must be drawn somewhere', it need not be absolutely defensible to the last foot."<sup>14</sup>

Many of the states and territories also seem to be concerned about the requirement that boundaries be described "in a manner which is sufficiently clear and exact to enable persons to determine whether property they use or an activity they propose to undertake is or is not located in the area subject to management."<sup>15</sup> This is certainly part of the explanation for the heavy use of existing political/cultural boundaries as a boundary development option. The concern over this requirement may have been overemphasized; particularly since the continued reading of the requirement cited above indicates that, "states must be able to advise interested parties whether they are subject to the management program within, at a maximum, 30 days of receipt of any inquiry."<sup>16</sup> However, this latter

requirement was not intended to be a criterion for boundary determination. In other words, the capability of making easy or clean decisions on boundary interpretations is not one of the criteria for judging the adequacy of a boundary, and, hence, should not be interpreted as suggesting the selection of an established political or cultural boundary. On the other hand, the boundaries are required to be definitive enough to comply with the requirements for determination of exclusion or inclusion within 30 days.

Another factor is that political circumstances may exist which dictates the use of a particular boundary option. In many cases, strong public sentiment against additional regulatory controls has induced states to keep the area under CZM control to a minimum. In other areas the existing laws and regulatory networks have had to be accommodated within the framework of the CZM program, thus limiting the options available for boundary development.

This section has provided an overview of the various boundary development methods and approaches used by other participating states and territories in the Coastal Zone Management Program. Each state or territory has its own unique problems which influence the particular boundary development option it selects. Hawaii can learn from the experiences of those jurisdictions but must also be aware of its own special limitations.

The following chapter analyzes the Hawaii Coastal Zone Management law in order to determine the specific limitations which may influence the selection of a boundary development option. Hawaii intends to use natural processes to help determine its inland boundary. However, the experiences of the other states and territories have shown that it will not be easy. In some cases the boundary development option selected may have to be arbitrary because some of the management requirements such as scenic and open space resources are not easily defined. Hawaii can still work toward reducing the amount of arbitrariness in the boundary selection process. A few states, such as Alaska and Florida, have shown this to be possible.



### SECTION III

#### SUMMARY OF ALTERNATIVES FOR INTERPRETING HAWAII'S CZM LAW

Although the Hawaii CZM Law (Chapter 205A, Hawaii Revised Statutes) provides little substantive guidance to the counties in amending their boundaries, it does specify that the amended boundaries must be consistent with the law's objectives and policies. It is important, therefore, to begin any discussion of criteria for boundary delineation/review with an examination of the law's objectives and policies to determine which are relevant to the determination of inland boundaries. Because of the nebulous manner in which the objectives and policies are stated, however, there are no definitive means of making this determination. Even a superficial reading of the objectives and policies would reveal that there is a range of criteria which may be developed, depending on how one interprets the language used. Therefore, the task of this chapter is to identify defensible alternatives for interpreting the objectives and policies.

A major difficulty encountered in interpreting the Hawaii CZM Law is the lack of consistency between the objectives and policies. The objective for scenic and open space resources, for example, reads as follows:

Protect, preserve, and, where desirable,  
restore or improve the quality of coastal  
scenic and open space resources. (emphasis  
added)

One of the policies for scenic and open space resources, however, reads as follows:

Preserve, maintain, and where desirable,  
improve and restore shoreline open space  
and scenic resources. (emphasis added)

There is a significant difference between the words "coastal" and "shoreline". The implication for inland boundary determination purposes would be quite narrow if "shoreline" was used as the basis for interpreting the scenic and open space element of the law. On the other hand, it would probably be much broader if "coastal" were used instead.

Another example of the inconsistency between objectives and policies involves the use of the term "in the coastal zone management area." When the term "in the coastal zone management area" is employed it may be inferred that a boundary exists. This term is used once in the objectives section, for the historic resources element and reads as follows:

Historic resources:

Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Thus, when referring to the objectives of the Act for guidance in determining a boundary, this interpretation implies that while historic resources should not be considered, recreational resources, scenic and open space resources, coastal ecosystems, economic uses, and coastal hazards would have to be considered for boundary determination purposes. A difficulty with this logic arises, however, since the term "in the coastal zone management area" is used in policies pertaining to recreational resources, scenic and open space resources, and economic uses; this would suggest that only coastal ecosystems and coastal hazards need to be considered in boundary determination.

The above examples are an indication of the dilemma encountered in interpreting the intent of the objectives and policies. Since there can be no definitive resolution of these dilemmas, three alternative interpretations of how the law and objectives and policies relate to the development of boundary criteria have been developed. These interpretations along with their assumptions, supporting rationale, and options for criteria are presented below.

ALTERNATIVE ONE: Coastal Ecosystems

Interpretation: The coastal zone management area shall be established based on a delimitation of coastal ecosystems.

Assumption-Rationale: The ambiguity of the objectives and policy makes any interpretation of the law difficult. Rather than basing assumptions on specific decisions involving objectives and policies, it may be wiser to look toward a broader basis for interpreting the law. The controlling purpose of Chapter 205A is to provide for the effective manage-

ment, beneficial use, protection, and development of the coastal zone. There are a number of functional reasons why a management element in the law (e.g., recreational resources, coastal hazards, etc.) may be considered for inclusion in the boundary. However, the overriding consideration is that it must be coastal in nature. The federal legislation provides a broad definition of coastal zone which reads as follows:

The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shoreline of the several coastal states, and includes transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends, in Great Lakes waters, to the international boundary between the United States and Canada and in other areas, seaward to the outer limit of the United States territorial sea. The zone extends inland from the shoreline only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal government, its officers or agents.<sup>1</sup>

In developing inland boundary criteria, the interpretation of "shorelands" is critical. The Federal CZM law does not clearly define shorelands. It states the shorelands and coastal waters are "strongly influenced by each other" and that the shorelands include "transitional and intertidal areas, salt marshes, wetlands and beaches." The inclusion of the phrase, "strongly influenced by each other," may be interpreted in an ecological context to mean that there are two-way exchanges of sustaining materials, energy, or biota between coastal waters and shorelands. With this interpretation the CZM boundary may be designated by identifying the ecological systems which sustain and are sustained by coastal waters. Thus, there is a basis for defining the inland coastal zone management area from the determination of coastal ecosystems.

The criteria which are identified through this process may be organized in several ways. Four different strategies will be described, each having different implications for the inland extent of the

boundary. These strategies were developed after analyzing the single objective and various policies pertaining to coastal ecosystems:

Objective: (4)(A). Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems;

Policies: (4)(A). Improve the technical basis for natural resource management;

(4)(B). Preserve valuable coastal ecosystems of significant biological or economic importance.

(4)(C). Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and

(4)(D). Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate State water quality standards. (Chapter 205A, HRS)

Objective (4)(A) and policies (4)(B), (4)(C), (4)(D) may be interpreted as providing guidance for amending the SMA boundaries. Policy (4)(A) is aimed at better natural resource management and is not a consideration for boundary delineation.

Objective (4)(A) and policy (4)(B) suggest that a case can be made for criteria based either on all ecosystems or only on valuable ecosystems. The choice of one or the other depends on how one interprets the use of these terms.

Policies (4)(C) and (4)(D) call for the "effective regulation of stream diversions, channelization", and prohibiting "land and water



uses which violate State water quality standards." Both of these policies call for action in areas in which other agencies, for example, the Department of Land and Natural Resources (DLNR) and Department of Health (DOH), have existing jurisdictional responsibility. If these areas are included within the CZM boundary entirely, at least two different management controls would be available for implementing policies (4)(C) and (4)(D) (e.g., Designated Groundwater Area Use Permit (DLNR), National Pollutant Discharge Elimination System Permit (DOH), and the Special Management Area Permit). Use of these policies, means that practically the entire state would have to be included within the CZM boundary because "in Hawaii, the major drainage basins are so close to the sea that it is virtually impossible to claim that what happens on one side of an artificial line has a direct and significant impact on coastal waters, and what happens on the other side does not."<sup>2</sup> For example, proposed developments in upland areas whose effluent discharges could affect coastal water quality would be subject to the CZM permit as well as the National Pollutant Discharge Elimination System Permit.

The discussion above has presented several choices which may be considered simultaneously. First of all the criteria may be based either on all coastal ecosystems or only on valuable coastal ecosystems. Second, a choice must be made between a very wide boundary with two overlapping management controls and a narrower boundary with minimally overlapping management controls.

These two choices are described in the two matrices shown in Figure 3.1 which indicates in four different strategies for organizing the boundary criteria. Alternative IV represents the alternative for the widest potential for the inland boundary. Alternative I represents the alternative for the narrowest boundary.

Figure 3.1

Alternatives for Organizing the  
Coastal Zone Management Boundary Criteria

	Single Purpose Management (non-CZM)	Comprehensive Management (CZM)
Valuable Coastal Ecosystems	I	II
All Coastal Ecosystems	III	IV

Source:

Pacific Urban Studies and Planning Program (PUSPP), Technical Considerations in Developing a Coastal Zone Management Program for Hawaii, Hawaii Coastal Zone Development Program, Document 1, August, 1975.

- Alternative I: all coastal ecosystems, with minimally overlapping management controls.
- Alternative II: valuable coastal ecosystems and land and water areas which may have impacts on coastal ecosystems, with two management controls.
- Alternative III: all coastal ecosystems, with minimally overlapping management controls.
- Alternative IV: all coastal ecosystems and land and water which may have impacts on coastal ecosystems, with two management controls.

## ALTERNATIVE TWO: Coastal Ecosystems and Coastal Hazards

Interpretation: The coastal zone management areas shall be established from the delimitation of coastal ecosystems and areas subject to coastal hazards.

Assumption-Rationale: Coastal ecosystems and coastal hazards are the only two management elements for which reference is not made to a pre-existing coastal zone, that is, where there are no "in the coastal zone management area" phrases in either the objectives and policies of Chapter 205A.<sup>3</sup> As stated earlier, a comparison of the objectives and policies reveals inconsistencies between them which present problems for interpreting the law. This dilemma is of concern for the recreation, scenic, and economic elements. Alternative One, above, went beyond the objectives and policies for interpretive guidance and, therefore, did not have to deal with any of the inconsistencies. Alternative Two, on the other hand, directly addresses these inconsistencies. Limiting the boundary criteria to the coastal hazards and coastal ecosystems management elements is based on a very precise and technical reading of the law. That is, that the phrase "in the coastal zone management area" precludes any use of these elements to draw boundaries because these elements presuppose an existing boundary. The boundary is then established without any consideration to objectives or policies which contain the above underlined phrase. This reading of the law assumes that the language of the law was very carefully chosen to precisely reflect the intent of the legislature.

The inconsistent objectives and policies for each of these sections will be presented below. Objective (1)(A), pertaining to recreation, states:

Provide coastal recreational opportunities accessible to the public.

In comparison, policy (1)(B) states:

Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area.

Objective (3)(A) for scenic and open space reads:

Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policy (3)(A) reads:

Identify valued scenic resources in the coastal zone management area.

Objective (5)(A) pertaining to the economic element reads:

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policy (5)(B) reads:

Insure that coastal dependent development such as harbors and ports, visitor facilities, and energy generating facilities are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area. (Chapter 205A, HRS)

The analysis of the objective and policies for coastal ecosystems was presented in Alternative One. Although it is part of Alternative Two as well, the discussion of coastal ecosystems will not be repeated. In other words, the first alternative is incorporated in Alternative Two; in subsequent discussion, the first and second alternatives will be incorporated in Alternative Three.

The objective and policies pertaining to coastal hazards read as follows:

Objective: (6)(A). Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Policies: (6)(A). Develop and communicate adequate information on storm wave, tsunami, flood, erosion, and subsidence hazard;

(6)(B). Control development in areas subject to storm wave, tsunami, flood, erosion, and subsidence hazard;

- (6)(C). Ensure that developments comply with requirements of the Federal Flood Insurance Program; and
- (6)(D). Prevent coastal flooding from inland projects.  
(Act 188, SLH 1977).

Objective (6)(A) and policy (6)(A) both indicate that the Hawaii CZM law is concerned about five different coastal hazards. These include tsunami, storm waves, stream flooding, erosion, and subsidence.

Policy (6)(B) mandates the Hawaii Coastal Zone Management Program (HCZM) to "control development" in areas subject to the five types of hazards identified previously. In order to comply with this policy, areas subject to these hazards will have to be included within the CZM boundary.

Policy (6)(C) mandates compliance with the requirements of the National Flood Insurance Program (NFIP).<sup>4</sup> In Hawaii, the maps being prepared for the NFIP will identify hazard areas for stream flooding and tsunami inundation based on the 100-year recurrence frequency. These maps are being prepared for each of the counties and should be ready in time for use in coastal zone management boundary delineation. The definition of flood or flooding for the NFIP includes storm wave hazards. However, storm wave hazard areas will not be specifically delineated in the NFIP maps because authorities feel that these areas will be incorporated within the tsunami hazard boundary.

Boundary implications of policy (6)(D) vary because that policy can be addressed in several ways. One way to view flooding hazard is at the downstream end, or the areas subject to inundation. Flooding in coastal areas will usually result from channel overflow onto adjacent land areas. If these adjacent land areas are adequately managed, flooding would continue to occur, however, the problem would be partially under control. For CZM boundaries; therefore, the minimum area necessary to control coastal flooding is the coastal flood plains.

Another way to deal with the flooding problem is to include within the management program, upslope activities within a drainage basin. Activities which change the natural ground cover in these upland areas reduce the ability of the land to absorb rain water and, hence, its ability to slow runoff. This results in greater amounts and faster rates of runoff, thereby causing more flooding downstream than

would otherwise occur for a storm of a given size. Policy (6)(D), therefore could justify extending the CZM boundary to include upland areas in order to address all such activities. This interpretation could greatly increase the land area subject to the CZM program requirements, depending upon which areas are deemed appropriate for management.

Analysis of the coastal hazards element indicates that there are numerous interpretations available for boundary delineation purposes. These may be developed into a range of options for boundary criteria as presented in Table 3.1.

Table 3.1

ALTERNATIVE TWO: RANGE OF OPTIONS FOR BOUNDARY  
CRITERIA BASED ON HAZARDS

Hazard	Minimum Inland Boundary	Maximum Inland Boundary
Tsunami	100-year recurrence frequency. (NFIP maps)	500-year recurrence frequency. (a)
Stream Flooding	100-year recurrence frequency. (NFIP maps)	Upland areas which may increase coastal flooding if developed.
Storm Waves	Area incorporated within the tsunami hazard boundary. (NFIP maps)	All areas with the potential for significant storm wave problems.
Subsidence	Areas identified as having experienced critical problems.	All areas with the potential for significant subsidence problems.
Erosion	Areas identified as having experienced critical problems.	All areas with the potential for significant erosion problems.

- (a) The suggested use of the line demarcating the 500-year tsunami recurrence frequency as the Maximum Inland Boundary is somewhat arbitrary. However, recognizing the dearth of information currently available for determining a maximum inland boundary based on tsunami hazards, any selection would necessarily be arbitrary to some degree.

Criteria based on Alternative Two include the coastal ecosystem as well as the coastal hazard elements. Land area may be designated for inclusion in the CZM boundary based on either one or both of these concerns.

ALTERNATIVE THREE: Coastal Ecosystems, Coastal Hazards, Coastal Recreational Resources, Coastal Scenic and Open Space Resources, and Economic Uses.<sup>5</sup>

Interpretation: The coastal zone management area shall be established from the evaluation of each management objective and policy stated in Chapter 205A for its independent contribution to the inland boundary.

Assumption-Rationale: Unlike Alternative Two, the third alternative is based on the assumption that a precise reading of Chapter 205A objectives and policies, is inappropriate. This alternative thus represents a counter argument to Alternative Two. In view of the way Act 188 passed, the functional importance of each management element and the overall intent of the program--which is to control development so as to mitigate social and environmental costs--it is hard to believe that the Legislature carefully chose its language for Act 188, SLH 1977, as demonstrated by the many inconsistencies contained within the law. With this in mind, Alternative Three reviews each objective and policy to determine its independent contribution to the inland boundary.

The analysis of the objectives and policies for coastal ecosystems and coastal hazards presented in the first two alternatives are also part of the third alternative, and will not be repeated in this section. The four areas of concern yet to be discussed for boundary determination purposes are recreation resources, historic, scenic, and open space resources and economic uses.

The objective and policies which pertain to recreation resources read as follows:

Objective: (1)(A). Provide coastal recreational opportunities accessible to the public.

Policies: (1)(A). Improve coordination and funding of coastal recreation planning and management; and

- (1)(B). Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:
- (i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;
  - (ii) Requiring replacement of coastal resources having significant recreational value, including but not limited to surfing sites and sandy beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;
  - (iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;
  - (iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;
  - (v) Encouraging expanded public recreational use of county, State, and federally owned or controlled shoreline lands and waters having recreational value;
  - (vi) Adopting water quality standards and regulating point and non-point sources of pollution



to protect and where feasible, restore the recreational value of coastal waters;

- (vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial reefs for surfing and fishing; and
- (viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, county planning commissions; and crediting such dedication against the requirements of section 46-6. (Chapter 205A, HRS)

Objective (1)(A) provides very little guidance for boundary determination purposes by itself. Read with the policies, however, several distinct interpretations can be made. Policy (1)(A) is aimed at planning and management and does not provide any guidance for boundary determination. With its supporting sub-elements, however, policy (1)(B) identifies several factors to consider for boundary delineation purposes.

Policy (1)(B)(i) presents an important consideration that may be interpreted in several ways. One interpretation of this policy is that "coastal resources uniquely suited for recreational activities that cannot be provided in other areas" are resources necessary for coastal dependent recreation. In other words only those coastal resources which are essential for specified recreational activities need be considered for protection. Other coastal resources which are utilized for recreational activities that can be located elsewhere should not be considered for protection under this interpretation.

In Hawaii, the ocean is a coastal resource uniquely suited for recreational activities that cannot be provided in other areas. Surfing, diving, fishing, and boating are all activities dependent on the ocean. These activities cannot be provided for elsewhere and

so the ocean should be considered for protection. A narrow boundary is being implied by this interpretation. The inland extent necessary to accomodate "coastal dependent" recreation includes the shoreline and back beach area necessary to provide parking and safe, easy access to the water.

Another interpretation of this policy is that recreation activities which cannot be provided elsewhere for whatever reason, should receive some consideration. These activities need not be coastal dependent but nevertheless, they do utilize coastal resources. Coastal resources may be used for hiking, camping, horseback riding, and nature appreciation. These activities may be accomodated in non-coastal areas. However, the State's limited land area places a premium on any land area which provides people with the opportunities to enjoy these activities. This interpretation would certainly have broader boundary implications than the interpretation of coastal dependency.

Policies (1)(B)(iii), (1)(B)(iv), and (1)(B)(viii) are also intended to provide the means to support the broader policy (1)(B). These policies could be important for boundary determination purposes because the supply of public access to the shoreline as well as shoreline parks and facilities suitable for public recreation is presently considered inadequate.<sup>6</sup> One of the principle limiting factors which stands in the way of government acquisition of access easements and additional park sites is inadequate funding. Policy (1)(B)(viii) advocates reasonable dedication of shoreline areas as an acceptable alternative to get around the money problem. This practice is already being implemented as part of discretionary approvals or permits issued by the Land Use Commission, Board of Land and Natural Resources, and County SMA permit authorities. These approvals may also be conditioned on the granting of public access to the shoreline.

The location of the CZM boundary could be an important factor in determining whether these policies can be carried out. In many areas of the State there are large tracts of land in private ownership which effectively block access to the shoreline. If the CZM boundary includes a public right-of-way like a coastal highway, any future action in the CZM area could be conditioned on the granting of public access from the highway to the shoreline. On the other hand, a narrow CZM boundary, which does not include public rights-of-way, will not provide the opportunity to remove any barriers.

However, too many problems would arise if boundary criteria were established solely for the purpose of providing access. The resulting boundary would include areas which could be inappropriate for coastal zone management. That is, a boundary based on such criteria may extend beyond the area necessary for controlling uses

which may have a direct and significant impact on coastal waters.

Policy (1)(B)(v) has some impact on boundary considerations but it will not be discussed further because it overlaps with other policies in this section.

Policy (1)(B)(vi) calls for the adoption of water quality standards and the regulation of point and non-point sources of pollution. The State Department of Health is currently engaged in a planning program to develop standards to regulate all point and non-point sources of pollution. If this policy is considered for boundary determination purposes, these two different management control systems would be available to implement this policy. The inland extent implied by this policy could conceivably include the whole state.<sup>7</sup>

The objective and policies which pertain to historic resources read as follows:

Objective: (2)(A). Protect, preserve, and, where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies: (2)(A). Identify and analyze significant archaeological resources;

(2)(B). Maximize information retention through preservation of remains and artifacts or salvage operations; and

(2)(C). Support State goals for protection, restoration, interpretation, and display of historic resources. (Chapter 205A, HRS)

Historic resources are not area-specific and can be located in coastal as well as non-coastal areas. The objective and policies in this section could apply no matter where the boundary was drawn. Archaeologists may argue, however, that it is vitally important to consider historic resources in boundary determination to assure that the integrity of entire settlement patterns which exist within the

designated coastal zone and extend outside those boundaries may be protected. Policy (2)(C) could provide the justification for this consideration if the protection of settlement patterns were a stated State goal. Unfortunately, State goals regarding historic resources are all very broad and do not specify settlement patterns for protection. Moreover, even if settlement patterns were to be used as criteria for boundary determination, the current lack of knowledge because of yet undiscovered or not thoroughly researched settlement patterns, would make such determinations uncertain or extremely costly by necessitating extensive field research. In light of these interpretations and circumstances, historic resources will not be a determining factor in identifying the CZM boundary.

The objective and policies pertaining to scenic and open space resources read as follows:

Objective: (3)(A). Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies: (3)(A). Identify valued scenic resources in the coastal zone management area;

(3)(B). Insure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;

(3)(C). Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and

(3)(D). Encourage those developments which are not coastal dependent to locate in inland areas.  
(Chapter 205A, HRS)

As stated earlier, objective (3)(A) and the policies in this section are inconsistent in their use of terminology. Objective

(3)(A)'s influence on boundary determination will depend on the definition of "coastal." This objective has the potential to extend the boundary far inland if the ecosystems approach (described earlier) is used to define "coastal."

Two policies in this section may be interpreted as providing guidance for amending the SMA boundaries: policies (3)(B) and (3)(C). Policy (3)(B) makes reference to "existing public views to and along the shoreline." It does not specify the location of vantage points from which observation of scenic views are to be protected. The width of the CZM area could vary widely depending on the location of the observation points with respect to the shoreline.<sup>8</sup> The guidelines in the SMA law, for example, specify views to the shoreline from the nearest coastal highway. On the other hand, if observation points are selected further inland, the CZM boundary would have to be much wider.

In comparison, policy (3)(C) is quite specific and implies a very narrow boundary as far as scenic and open space resources are concerned. Shoreline open space and scenic resources are limited, by definition, to vantage points and objects of observation along the shoreline. In this case the observation point and points to be observed have been specified and, therefore, little room is left for interpretation.

The objective and policies pertaining to economic uses read as follows:

Objective: (5)(A). Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies: (5)(A). Concentrate in appropriate areas the location of coastal dependent development necessary to the State's economy.

(5)(B). Insure that coastal dependent development such as harbors and ports, visitor industry facilities, and energy generating facilities are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in

the coastal zone management area; and

(5)(C). Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

- (i) Utilization of presently designated locations is not feasible;
- (ii) Adverse environmental effects are minimized; and
- (iii) Important to the State's economy. (Chapter 205A, HRS)

The term "coastal dependent" will again be a factor in determining the inland extent of the CZM boundary. In this case the range of possible interpretations is limited by policy (5)(B). Policy (5)(B) specifies harbors, ports, visitor industry facilities, and energy generating facilities as coastal dependent development. This indicates that coastal dependency is not limited to dependency on the use of coastal resources but, rather, is expanded to include activities which, if not located adjacent to coastal resources, would result in a loss of quality in the goods or services provided. For example, hotels in Hawaii are not dependent on the use of coastal resources but the quality of the visitors experience may be enhanced by proximity to the ocean and sandy beaches.<sup>9</sup>

Many of the locations suitable for coastal dependent economic development are already designed for such use in County General Plans and Zoning Ordinances. In any event, the criteria for this element should remain flexible because its importance is more for management purposes than for boundary designation.

A range of options for interpreting each element can be provided for Alternative Three. The options for coastal ecosystems and coastal hazards have been presented earlier. The options for the recreation,

scenic and open space, and economic uses elements are presented in Table 3.2.

Table 3.2

OPTIONS FOR ORGANIZING THE BOUNDARY CRITERIA:  
RECREATION, SCENIC AND OPEN SPACE AND ECONOMIC USE ELEMENTS

	Boundary Options	
	Minimum	Maximum
Recreation Resources	Coastal resources uniquely suited for recreation activities that cannot be provided in other areas.	Nearly the whole stage. (the area necessary to control point and non-point sources of water pollution.)
Scenic and Open Space Resources	Vantage points and objects of observation to and along the shoreline	Up to the headwaters of perennial streams. (The inland extent of the ecological definition of coastal)
Economic Uses	Existing areas designated for coastal dependent activities. (Zoning or General Plan designation)	Up to the headwaters of perennial streams. (The inland extent of the ecological definition of coastal)

All three alternatives presented in this chapter appear to be legally defensible interpretations of how the Hawaii Coastal Zone Management Law's objectives and policies might influence the development of boundary criteria. However, only one of the alternatives can be described as maintaining the "spirit" of the law. As indicated by the summary table, Table 3.3, Alternative Three is the most comprehensive option and it will address all of the management elements but one--historic resources. For this reason, the third alternative interpretation will be used to develop the boundary criteria.

Although a range of options was provided, only the minimum will be used. This provides a base line for the governmental agencies to use, in particular, the review of boundaries for minimal compliance, but does not restrict them from expanding the concerns that will be addressed by the boundary criteria.



TABLE 3.3

## Summary Table

		<u>Minimum</u>	<u>Maximum</u>
ALTERNATIVE 1	Ecosystems	①. All coastal ecosystems, with minimally overlapping management controls	2. All coastal ecosystems and land and water areas which may have impacts on coastal ecosystems, with two management controls.
		③.* Valuable coastal ecosystems, with minimally overlapping management controls	4. Valuable coastal ecosystems and land and water areas which may have impacts on coastal ecosystems, with two management controls
ALTERNATIVE 2	Hazards	①. Tsunami - 100-year recurrence frequency (NFIP maps)	2. Tsunami - 500-year recurrence frequency
		③. Stream flooding - 100-year recurrence frequency (NFIP maps)	4. Stream flooding - upland areas which may increase coastal flooding if developed
		⑤. Storm waves - area incorporated within the tsunami hazard boundary	6. Storm waves - all areas with significant storm wave problems
		⑦. Subsidence - areas identified as having experienced critical problems	8. Subsidence - all areas with significant subsidence problems
		⑨. Erosion - areas identified as having experienced critical problems	10. Erosion - all areas with significant erosion problems
Recreation Resources	①. Coastal resources uniquely suited for recreation activities that cannot be provided in other areas	2. Nearly the whole state (area necessary to control point and non-point sources of pollution)	
Scenic and Open Space Resources	①. Vantage points and objects of observation to and along the shoreline.	2. Up to the headwaters of perennial streams (the inland extent of the ecological definition of coastal)	
Economic Uses	①. Existing areas designated for coastal dependent activities (zoning or General Plan designation)	2. Up to the headwaters of perennial streams (the inland extent of the ecological definition of coastal)	

\* Circled numbers indicates the options which are being recommended.



## SECTION IV

### BOUNDARY CRITERIA

This section identifies possible criteria for the minimum inland boundary for Hawaii's CZM Program and explains the rationale for identifying the boundary criteria for each of the management concerns which have a bearing on the determination of the boundary. A set of criteria has been developed for each management concern which reflects the values for special management consideration. All of the separate sets of criteria will be summarized at the end.

#### Recreation Resources

The shoreline areas and the coastal waters of Hawaii provide a wide variety of recreational opportunities for residents and visitors alike. While Hawaii's coastal resources are well suited for diverse recreational activities, there are also wide varieties of constraints to the provision and enjoyment of coastal recreation. These constraints include a limited supply of quality resources, competing uses for coastal resources, and shoreline access problems. To get a better idea of recreational demand, supply, and needs in Hawaii's coastal areas some of the findings from the State Comprehensive Outdoor Recreation Plan (SCORP) are presented below.<sup>1</sup>

1. On a peak day, Hawaii's residents and visitors generate more than 782,000 activity occasions (activity occasions represent the number of separate times an individual engages in an activity in a given time period). The "average" resident accounts for more than four activity occasions per week.
2. Outdoor recreation in Hawaii is oriented to the sea, with more than 50 per cent of total participation occurring at shoreline areas or offshore waters.
3. Swimming/sunbathing is the most popular of the 19 types of activities surveyed, accounting for over one-fourth of total activity in the State. Swimming/sunbathing is the preferred leisure time activity on all islands.
4. The SCORP Outdoor Recreation Resource Inventory lists 2,246 of sandy beach acres in Hawaii.

These areas should not be considered completely available to the public, as access to many sites is contained by physical or legal impediments. Three hundred twenty-seven acres front or are adjacent to improved public parks, harbors, etc. With over 70 acres, Maui County has more gross sandy beach area than other Counties; Hawaii County has the least.

5. The State has a supply of 1,714 campsites, with most situated at shoreline recreation areas. Five hundred forty-five of these sites are located on Hawaii; 529 on Oahu; 461 on Kauai; and 179 in Maui County...
6. Based upon current and projected participation rates and available supply, all Counties display a high need for campsites at shoreline areas...
7. There is enough beach space on Kauai and Maui to accomodate island swimming/sunbathing activities; however, on Oahu and Hawaii need is critical.
8. Statewide current need for boat moorages is moderate, but, based on existing supply, by 1990 all counties will experience heavy deficiencies (on Oahu demand already exceeds supply)...
9. Resource-based activities such as fishing, diving, and surfing will continue to experience substantial popularity; therefore, measures to preserve the quality and availability of (and access to) ocean recreation resources should continue to be promoted.

These findings provide the background setting for determining the recreational component of the inland boundary criteria. The findings indicate that coastal recreational activities are popular and that suitable resources are limited. For a number of activities, swimming/sunbathing in particular, present demand has already created "overloaded" conditions. The task at hand, as finding number nine indicates, "is to preserve the quality and availability of (and access to) ocean recreation resources"<sup>2</sup> The recreational component of the inland boundary criteria, therefore, is designed to consider all

coastal recreational resources for coastal zone management control. There will be no need to rank sites to determine relative value for recreational activities. The assumption being made is that limited supply and increasing demand for coastal recreational resources has created a situation of scarcity, vulnerability, and fragility. This makes all coastal recreational resources "critical" for management purposes.

Coastal recreation resources must be identified before they can be managed. A three-step process has been used here to identify those resources which are important for coastal recreational activities. The first step involved a review of several recreation reports and studies from which a list of coastal recreation activities was identified. Further review of studies provided information for the second step in the process. For each of the coastal recreation activities identified in the first step, a description of coastal resource characteristics required by these activities was developed. The third and final step identified specific ecosystems (resources) which were described by the resource characteristics in step two.<sup>3</sup> The end result of this three step process is presented in Figure 4.1. Each of the ecosystems identified as having recreational value will be discussed below.

The resources identified in Figure 4.1 can be broadly grouped into three classifications. These are inland waters, shoreline features, and marine bottom subtypes.<sup>4</sup> Three inland water subtypes have been identified including perennial streams, coastal wetlands, and estuaries.<sup>5</sup> The shoreline subtypes are rocky and sandy shorelines. The marine bottom subtypes include nearshore reef flats, calm water coral communities, artificial basins, offshore reef flats, wave exposed reef communities.

#### Inland Waters

The State Department of Health's "208" Technical Committee on Water Quality Standards defines inland waters as "water flowing year-round in all or part of natural channels as a result of both surface runoff and groundwater influx."<sup>6</sup> High quality perennial streams provide a significant contribution to coastal recreation activities. First of all, perennial streams serve as locations for several unique recreational activities, such as fishing for native diadromous species including, "five fishes (o'opu), two shrimps (opae), and at least one mollusk (hihiwai)."<sup>7</sup> An introduced diadromous prawn is also highly sought. Swimming and slippery rock or mud sliding are other recreational activities which utilize perennial streams.

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Several marine-related fishes inhabit the lower reaches of streams as juveniles and require good quality streams for survival. These include the aholehole and the amaama (mullet), both of which are prized catches for local fishermen because of their good eating qualities. In addition, streams affect the marine fisheries resource by contributing large quantities of diadromous larvae to the zooplankton trophic base of coastal waters. This surely has a significant impact on the marine ecosystem.<sup>8</sup>

Stream channels and the adjacent soils which are saturated with water most of the year (wetlands) are valuable for recreational purposes because they act as buffer zones which reduce the degradation to, and losses of, valuable aquatic ecosystems. The natural vegetation in the buffer zone may allow aquatic systems to perpetuate by (1) maintaining a balanced nutrient regime, (2) moderating water temperatures by shade, (3) providing organisms with food sources, (4) reducing the scouring of stream bottoms, and (5) reducing sedimentation through control of runoff and erosion.

Coastal wetlands, including freshwater, mixohaline<sup>9</sup> and saline systems, are defined as those lowland areas "subject to periodic or permanent inundation during the growing season which causes the selection of a group or an association of plants that can tolerate the wet conditions."<sup>10</sup> These areas may range from open water ponds to densely vegetated marshes, or some combination of the two. This distinct class of aquatic ecosystem is important for a range of recreational activities broadly termed biological observation. Coastal wetlands are important to bird watchers because these areas serve as habitats for resident and migratory waterbirds. Included among them are five endemic waterbirds, all listed as "endangered" on the most recent Federal list of endangered and threatened birds of the United States. These include the Hawaiian Stilt, Hawaiian Coot, Hawaiian Gallinule, Hawaiian Duck and Laysan Duck.<sup>11</sup> Other species which may be observed in coastal wetlands include sandpipers, plovers, turnstones (all shorebirds), stilts, avocets, herons, egrets, and bittens (wading species).

Coastal wetlands are also the habitat of plants classified as hydrophytes, "plants which are adapted for growth only in water or in soils containing excessive amounts of water."<sup>12</sup> "These include free-floating or floating leaved aquatics as well as emergent hydrophytes, plants which root in saturated soils, often under shallow water, but extend their shoots above the water. Obligate hydrophytes often display morphological or structural mechanisms, which allow them to cope with their unusual oxygen deficient environment."<sup>13</sup> A list of hydrophyte species recently observed on field studies done in Hawaii's wetlands is provided in Table 4.1. The wetlands ecosystem

provides the opportunity to observe esthetic as well as botanical diversity in the coastal areas of the state.

As defined by the Department of Health's "208" Technical Committee on Water Quality Standards study, estuaries are "deep misohaline coastal waters in well-defined basins that have continuous and frequent surface connection to the ocean". "Natural estuaries occur mainly at stream mouths but a few receive input from freshwater springs. Developed estuaries have basins that are man-made or strongly modified from a natural state."<sup>14</sup> Hawaii's estuaries are utilized for several types of recreational activities including swimming, boating, fishing, crabbing, oyster picking, clamming, and limu picking. As indicated, estuaries harbor oysters, clams and algae (limu 'ele'ele, ogo, limu manaua, limu huna, limu papahapa) as well as other species utilized for food such as the Samoan crab, amaama, awa, kaku, and aholehole. Many estuaries are found adjacent to calm water areas and therefore offer protected waters for swimming and boating.

#### Shoreline Features

Sandy beaches are probably the single most important coastal recreation resource aside from the ocean itself. Descriptively, beaches are divided into the foreshore and the backshore.<sup>15</sup> The foreshore, which consists of the sloping part of the beach between the low water level and the crest of the most seaward berm, is intensively used. Safe access in and out of the water is a primary requirement for many recreational activities such as swimming, surfing, diving, and light craft boating. For these activities, the sandy beach foreshore serves as the main avenue for safe entry to and exits from the ocean. Some coastal zone enthusiasts may utilize the foreshore area of the sandy beach without ever reaching the water. This category of users may include sunbathers, beachcombers, shore casters, and limu pickers. Body surfers, on the other hand, require shore breaks onto sandy bottoms in the area immediately seaward of the foreshore area.

The backshore is "the generally flat part of the beach lying between the seaward berm crest and the coastline where the coastline is the beginning of dunes, permanent vegetation, seacliff, marsh, or a man-made structure."<sup>16</sup> While not used as intensively as the foreshore, the backshore still serves as an important resource for several coastal recreational activities. These activities include sunbathing, beach picnicking and beach camping. The backshore is often used as storage areas for outrigger canoes and some light craft sailing vessels as well.



TABLE 4.1

## OBLIGATE HYDROPHYTES RECENTLY OBSERVED IN HAWAII'S COASTAL WETLANDS

Scientific Name	English Name	Hawaiian Name	Status
<u>Azolla filiculoides</u> Lam.	Azolla; water fern	---	Exotic
<u>Bacopa monniera</u> (L.) Wettst.	Water Hyssop	---	Indigenous
<u>Brugiera gymnorhiza</u> (L.) Lam	Oriental Mangrove	Kukuna-o-ka-la	Exotic
<u>Ceratopteris siliquosa</u> (L.) Copel	Swamp Fern	Hihiawai; palai kahawai	Exotic
<u>Cladium leptostachyum</u> Nees & Meyen	Native sawgrass	'Uki	Endemic to the Hawaiian Islands
<u>Cyclosorus gongyloides</u> (Schk.) Link	Swamp cyclosorous	---	Exotic
<u>Cyperus difformis</u> L.	---	---	Exotic
<u>Cyperus laerigatus</u> L.	Smooth flatsedge	Makaloa	Indigenous
<u>Cyperus papyrus</u> L.	Papayrus	Kaluhā	Exotic
<u>Egeria densa</u> Planch.	Water weed	---	Exotic
<u>Eichormia crassipes</u> (Mart.) Solms	Water hyacinth	---	Exotic
(continued)			

TABLE 4.1 Continued

Scientific Name	English Name	Hawaiian Name	Status
<u>Elocharis acicularis</u> (L.) R. & S.	Spike Rush	---	Exotic
<u>Eleocharis geniculata</u> (L.) R. & S.	Spike Rush	---	Exotic
<u>Eleocharis obtusa</u>	Spike rush	Pīpī wai, kohekohe	Indigenous
<u>Ipomeoa aquatica</u> Forsk.	Swamp cabbage	---	Exotic
<u>Lemna minor</u> L.	Duckweed	---	Exotic
<u>Ludwigia octivalvis</u> (Jacq.) Raven	Primrose willow	Kāmole	Exotic
<u>Ludwigia palustris</u> (L.) Ell.	Water purslane	---	Exotic
<u>Monochoria vaginalis</u> (Burm. f.) Kunth	Cordate monochora	---	Exotic
<u>Myriophyllum brasiliense</u> Cambess	Parrots feather	---	Exotic
<u>Nasturtium microphyllum</u> Boenn. ex Reichenb.	Watercress	Leko; Lēkō- ke'oke'o	Exotic
(continued)			

TABLE 4.1 Continued

Scientific Name	English Name	Hawaiian Name	Status
<u>Nelumbo nucifera</u> Gaertn.	Indian lotus; lotus	---	Exotic
<u>Nymphaea</u> Spp.	Water lily	---	Exotic
<u>Paspalum vaginatum</u> Sw.	Seashore paspalum; biscuit grass	---	Exotic
<u>Pistia stratiotes</u> L.	Water lettuce	---	Exotic
<u>Potamogeton foliosus</u> Raf.	Leafy pondweed	---	Exotic
<u>Rhizophora mangle</u> L.	American mangrove; red mangrove	---	Exotic
<u>Ruppia maritima</u> L.	Widgeon grass	---	Indigenous
<u>Sagittaria</u> <u>Sagittariaefolia</u> L.	Arrowhead	---	Exotic
<u>Scirpus californicus</u> (C.A. Meyer) Stend.	Great bulrush	---	Exotic
<u>Scirpus paludosus</u> A. Nels.	---	Makai	Indigenous
<u>Scirpus rockii</u> Kuek.	Rock's bulrush (continued)	Kaluhā	?

TABLE 4.1 Concluded

Scientific Name	English Name	Hawaiian Name	Status
<u>Scirpus validus</u> Vahl.	Great bulrush	Neki; 'aka 'akai; nanāku	Indigenous
<u>Spirodela polyrrhiza</u> (L.) Schleid	Greater duckweed	---	Exotic
<u>Typha angustata</u> Bory & Chaubord	Cattail	---	Exotic

SOURCE: Margaret E. Elliott and Erin Marie Hall, Wetlands and Wetland Vegetation of Hawaii, prepared for the U. S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, Contract #DACW 84-77-C-0014, September 1977.

Rocky shoreline areas in Hawaii are primarily composed of basaltic lava. Calcareous shoreline, "hard surfaces built by the consolidated lime skeletons of marine plants and animals," are also widespread on the older islands.<sup>17</sup> Rocky coasts have various characteristics including vertical shores, benches, and boulder beaches. Recreational use of exposed rocky shorelines is limited to fishing, opihi or pipipi picking, limu picking and crabbing. Rocky shorelines on leeward or protected coasts may also provide access to the water for activities such as spearfishing, netting, and diving.

Seacliffs and benches may serve as platforms for various types of shore casting fishing. These areas also serve as habitat for several island delicacies such as pipipi (a sea snail), a'ama crabs, and the opihi (another sea snail). Various types of limu including 'aki'aki, kohu, 'ele'ele, huluhuluwaena, and kala, may be found in this environment. Few organisms inhabit the boulder beach habitat, the most notable being the a'ama crabs.

#### Bottom Subtypes

Hawaiian nearshore reef flats are shallow platforms, at water depths of 0 to 3 meters, composed of reef rock derived from the skeleton of a variety of reef-dwelling marine organisms.<sup>18</sup>

Nearshore reef flats include both apron and fringing reef types. The former represents an earlier stage in reef growth leading to the latter. Apron reefs are smaller and project out from the shoreline as semicircular aprons while fringing reefs are more extensive and form wide continuous flats parallel to the coastline for long distances.

Nearshore reef flats provide opportunities for a wide variety of recreational activities. The reef flats serve as natural breakwaters providing calm water conditions for swimming, diving, snorkeling, and light craft sailing. Offshore breaks, the ideal for surfing may also be present because of the shoaling effects of the reefs. Habitat for octopus, lobster, limu, crabs and finfish is also provided. Nearshore reef flats also provide a source of sand to replenish white sand beaches.

"Offshore reef flats are shallow submerged platforms, or shoals, of reef carbonate occurring at water depths of 0 to 3 meters and separated from the shoreline of high islands by wide deep lagoons or ocean expanses."<sup>19</sup> The only example of offshore reef flats in the

populated Hawaiian Islands occurs offshore from Kaneohe Bay on Oahu. The calm water landward of the offshore reef flats is ideal for swimming, diving, fishing, netting, and small craft sailing. Important spearfishing and fishing species which inhabit offshore reef flats include uhu, maomao, kole, manini, weke, and kumu.

"Wave exposed reef communities are the most extensive shallow marine habitats in Hawaii and are subjected to heavy or continuous coastal wave action."<sup>20</sup> These communities may range in water depths from 0 to 40 meters with substratum composed of basalt or carbonate rock with sand channels and depressions also present. Wave exposed reef communities provide food and shelter for important recreational fishing resources including uhu, kumu, lobster, kole, manini, mamu, weke, and Kona crab. Surfing, swimming, and diving activities also occur in this area.

Protected coral communities are generally found along leeward coasts, bays, or coves where exposure to wave energy is limited. Water depth ranges from 0 to 40 meters but the best developed are found at depths below 10 meters (water depth below the wave base). The bottom is dominated by live coral which covers over 50% of the surface. Sand patches and channels are also present. Protected coral communities provide the best recreational diving sites for spearfishing or aesthetic enjoyment. This environment provides the greatest abundance and variety of reef fishes in Hawaii including kole, maomao, u'u and manini. The clean, protected waters also provide good opportunities for swimming and boating activities.

Artificial basins are transformed natural embayments, coastlines or estuaries used for commercial deeper water harbors or small boat harbors. They are characterized by dredging, man-made structures and other human activities either in the water or along the shoreline. Artificial basins serve a variety of recreational activities besides boating. Several species of fish are caught within artificial basins including papio, aholehole, mullet, kaku, iao, omaka, and akule. Swimming, diving, and limu picking are also pursued here. Limu which may be found in artificial basins include: 'ele'ele, ogo, huna, and papahapaha.

In addition to these ecosystems, one of the most important resource characteristics which must be maintained for a majority of coastal recreation activities is clean, unpolluted water. All water contact sports such as surfing, diving, swimming, and water skiing as well as consumptive activities such as fishing, clamming, crabbing and limu picking require unpolluted water for the following reasons:

1. Physical hygiene - a number of pathogenic organisms are known to survive in salt water and may be transmitted through direct contact or by consuming flora and fauna grown in polluted waters. These bacterial and viral organisms may cause skin, mucuous, and internal infections.
2. Performance safety - good underwater visibility is required to avoid rocks, coral heads, and other hazards by surfers, swimmers, boaters and water skiers. Murky water will also present orientation problems for swimmers and divers.
3. Esthetic enjoyment - good underwater visibility is essential for the enjoyment of observing fish, coral, and other elements of the marine environment. Revulsion may even replace pleasure if the water offends the participant through sight, feel, or smell.
4. Ecosystem health - polluted waters may harm marine ecosystems of interest and need to users by overpowering their natural cleansing and filtering systems.

#### Scenic and Open Space Resources

Hawaii's scenic and open space resources are highly valued by both residents and visitors alike. The significance of these resources to the residents of the state is not restricted to aesthetic enjoyment.

It is particularly important for Hawaii's economic well being to protect and preserve the visual and cultural environment because the tourist industry is the direct result of man's attraction to a quality environment.<sup>21</sup>

A recent State Plan technical<sup>22</sup> study states that:

The visitor industry is clearly the most important industry in Hawaii--it is the largest contributor to Hawaii's economy, it has by far the strongest growth potential of the major industries, and its

rate of growth and location can be more easily influenced than it can with other major industries."

While Hawaii's major industry benefits directly from the scenic and open space resources of the state, it is also a primary threat to their degradation. This situation requires effective management of the scenic and open space resources in order to maintain a balance between economic growth and the environment which makes that growth possible. Nowhere are the stakes higher nor the conflict greater than along the shoreline.

Although most can agree that scenic and open space resources are valuable, few can agree about the specific ingredients which determine their quality. The PUSPP recommendation memo for Hawaii's CZM Program on natural aesthetic resources identifies this quandry to be a major management problem:

"Judgement of what is aesthetically appealing can vary greatly from individual to individual depending on complex factors in each individual's experience and personality." "The result is that planners lack trustworthy methods of assessing natural aesthetic values and for evaluating the impact of development on such values."<sup>23</sup>

Planners at both the state and county levels must deal with this problem when assessing coastal zone management boundary options. The question of immediate concern is how can the scenic and open space resource concerns influence the determination of a coastal zone boundary?

What are scenic and open space resources and how may they be defined? The PUSPP recommendations memo for the CZM Program on natural aesthetic resources provides the following definitions:

Open space is vegetated or landscaped land on which a minimum of man-made structures have been constructed. Such lands are usually used for recreational, agricultural, or forest purposes.

Scenic areas include viewsheds and specific sites. Viewsheds are large areas that are suitable for comprehensive management because of their overall appeal. Sites are locations valued either due to their intrinsic quality or because they provide a vantage point overlooking a scenic view.<sup>24</sup>

While the definition for open space is relatively straightforward, it should not be restricted to vegetated terrain. Nonvegetated terrain may also be considered open space. The definition of scenic areas is not so clear and may require interpretation of these values on a site specific or case by case basis.



The definition for scenic areas implies that as a minimum, a process for identifying viewsheds and scenic sites, which provide the opportunity for public review will have to be developed. At the state level there is no officially adopted register or list identifying valued scenic or open space resources for protection. Several surveys have been done but their methodology for identifying valued resources did not involve public review or input.<sup>25</sup> While criteria for identifying valued sites may have been specified for some of these surveys, particularly the State Open Space Plan, the criteria was based only on the judgements of the consultants involved. This is not sufficient because "a highly valued aesthetic resource, like Diamond Head, derives its value from the widespread agreement that it possesses such qualities."<sup>26</sup> (Emphasis added). Without public involvement, these surveys will necessarily lack the necessary determination of public agreement that identified scenic areas possess such qualities. Two other counties, Kauai and Hawaii, have designated important open space areas and scenic views in their general plans. Since general plans require public hearings prior to their adoption, those scenic and open space areas designated in the Kauai and Hawaii plans have some measure of credibility that the other surveys do not. Other county planning documents including development plans and urban design plans may also identify important scenic and open space resources.

Thus, it appears that the counties will have several options when considering the influence of the scenic and open space element on the coastal zone management boundary. The ideal solution would be to develop and implement a classification system for making an assessment of the quantity and quality of the state's coastal scenic and open space resources. While this may be a long range goal, neither the state nor the individual counties has taken on this laborious, time consuming, and expensive task prior to the deadline for designating a CZM boundary.<sup>27</sup>

A second alternative will be to utilize the available information from the surveys which have been identified earlier. If these surveys are utilized, it should be with the understanding of their limitations. Counties such as Kauai and Hawaii may wish to utilize the data developed in their general plans or any subsequent planning documents which have been developed with citizen input and review. The problem with this alternative is that the data may be dated or that the plans often lack comprehensive coverage of the whole county. For these areas not covered, some other method will be needed.

The data identifying valuable coastal scenic and open space resources in the State of Hawaii needs to be improved, therefore, the coastal zone management boundary should be developed with the

intention of preserving alternatives until further studies can be developed. If existing surveys are used, potentially valuable scenic and open space resources may not even receive consideration for CZM management. The alternative which is proposed here will not identify specific scenic sites (vantage points or objects of observation). Instead the approach will focus on identifying scenic and open space attributes which aid in determining mapable classifications of these resources. Various studies and reports will be utilized for identifying scenic and open space attributes and the particular classification scheme which may be applicable. Examples of classification schemes which may be used include ecosystems, physiographic types, and geologic features. These attributes and resource classifications are presented in Table 4.2. A discussion for the component parts follows:

Bays have "high scenic values because they are a natural moment of 'unity' along the coastline".<sup>28</sup> They have a naturally enclosed, semi-circular configuration which provides different views at each place along the coastline. These views are generally quite broad, taking in a wide perspective with significant depth. On the other hand, coves provide a more intimate setting. The partially enclosed configuration provides a restricted view with a more narrow focus than bays.

Estuaries and lagoons have a high degree of closure with a fairly uniform setting. Protection from the open sea provides a calm, tranquil environment of calm waters and dense vegetation along the shoreline. The mangrove (*Rhizophora mangle*) and hau (*Hibiscus tiliaceus*) may be found growing along the coastal edges of estuaries. The mud flats and marshland fringing an estuary may serve as habitat for the Hawaiian Stilt, one of five endangered waterbirds found in the State of Hawaii.<sup>29</sup>

Rivers and streams offer a variety of scenic and open space qualities. The movement of the water, ranging from a lazy gentle flow to the dynamic crashing rapids, can complement many different moods. From a broader perspective the various channel patterns and contrasting color schemes add variety and diversity to the landscape.

The vertical enclosure created by steep walls gives the broad valley land form unique and scenic qualities. A view from the shoreline into the valley provides many striking contrasts. The delicate white variegations of waterfalls and plunge pools complement the darker hues of deep green, brown and black which color the valley walls; all of which contrasts with the deep blue of the ocean. Differences in texture between water, land and vegetation are also apparent.

Basalt benches and low cliffed coasts on windward or wave exposed shorelines exhibit dynamic water movement. Large waves breaking

powerfully on these rocky shorelines may send spectacular sprays of water high into the air. In addition, blowholes or spouting horns may be found on wave cut basalt benches. They result from "compression of air in lava tubes or sea caves at water level as waves move into them. The air escapes through a hole in the roof of the cave, often driving ahead of it a jet of water and carrying spray high into the air."<sup>30</sup>

Beaches possess unique qualities of texture and color among Hawaii's shoreline features. Beach material may consist of pebbles, cobbles, boulders or sand. Sand beaches in Hawaii may not necessarily be the white or cream colored beaches popularized by the tourist post cards. Black sand, gray, brownish gray and even green sand beaches may be found. From afar, the color qualities of beaches provide a contrasting feature to the landscape. Close range viewing may highlight the textured differences between beaches and the surrounding elements.

The coastal wetlands provide unified vegetative color and grain when viewed from a broad perspective. Closer inspection will reveal that a wide variety of species and characteristics are present in wetland environments. Characteristics may range from short floating plants (azolla, water hyacinth, duckweed, water lettuce) to tall prominent plants (native sawgrass, papyrus, cattail).<sup>31</sup> The coastal wetlands also provide the opportunity for viewing five endemic water-birds listed as endangered (Hawaiian Stilt, Hawaiian Coot, Hawaiian Gallinule, Hawaiian Duck, Laysan Duck).<sup>32</sup>

Flood plains possess valuable scenic and open space qualities, often providing diversity and color alongside predominantly built up areas. These flattened areas may exhibit water-tolerant vegetation (Dayflower, honohono, California grass, umbrella sedge).<sup>33</sup> Many flood plain areas are valuable for open space merely because they provide visual relief from man-made environments.

Elevated reefs, sand dunes, and beach rock are all physical features of marine origin. Elevated reefs are former fringing reefs or remnants of them and emerged because of a fall in sea level in relation to the land. The rough, irregular surface of elevated reefs provides an interesting and scenic landscape. Sand dunes are highly variable because they may migrate and change their shape subject to blowing wind. In Hawaii, longitudinal dunes, which form fairly straight ridges parallel or at right angles to the wind, are common.<sup>34</sup> The gently rolling, rounded forms may also be found. Lithified sand dunes also provide a visual diversity even though they are no longer migrating. Interesting visual patterns are apparent because they are highly erodible with an irregular surface.

TABLE 4.2

## SCENIC AND OPEN SPACE RESOURCES

Basic Categories	Specific Categories	Attributes Which Aid in Determining Classification as Scenic Resources	Geographic Example
Water Bodies	open bays/ shelf waters	*sandy bottom visible from high vantage points	Hanauma Bay, Kahoua Bay, Kahakuloa, Maui
		*broadly-enclosed configuration	Waimea Hulopoe Bay
	coves	*partially enclosed configuration/ partly unseen	Shark's Cove
		*complex shoreline, as with compound coves	Waloua
	estuaries/ lagoons	*high degree of closure	Kaneohe
		*waterfowl (endangered and threatened species), marsh and tidal (estuarine ecosystem) aspects	Pearl Harbor
	river mouths	*dynamic movement/ebb	Hanalei
	streams/ rivers	*dynamic movement/ebb and flow of tides, meeting of the waters	Wailua
		*gradient changes--e.g., waterfalls at fall lines, rapids and shoals	Wailuku
(continued)			

TABLE 4.2 Continued

Basic Categories	Specific Categories	Attributes Which Aid in Determining Classification as Scenic Resources	Geographic Example
Water/Land Interface	stream/rivers continued	*distinctive channel pattern including: -braided-islands, pools and riffles -looped meander-gentle reverse curves -branched channels	
	broad valley land form	*vertical enclosure created by steep walls adjacent to narrow water body	Pololu, Waipio
		*rocks and shoals visually prominent	Waimanu, Halawa
	basalt benches low cliffed coast	*dynamic water movement-heavy surf and wave action, water breaking dramatically on rocky shoreline	Puna coastline
	blowholes	*spectacular spray of water spouting as high as 100 feet or more into the air	Lawai, Kauai; Makapuu, Oahu
	beaches	*unique color or texture--as in white or black sand, gravel, cobbles, coarse boulders, calcareous beaches	Sandy Beach, Poipu, Makena
	(Coastal Wetlands) salt/fresh water marshes	*unified vegetative color and grain *waterfowl, marsh fauna apparent	Kealia Kawainui
(continued)			

Table 4.2 Continued

Basic Categories	Specific Categories	Attributes Which Aid in Determining Classification as Scenic Resources	Geographic Example
Land Forms		*ecosystem function apparent	Kawainui
	riverine flood plains	*periodic inundations during spring or storm flooding	Hanalei
		*flatlands with inundation-tolerant typical vegetation	Wailua
	elevated reefs	*diversity of land type--of marine origin	Barbers Point, Kaena Point
	sand dunes	*pure sandy surface--gently rolling/rounded forms accentuated by lack of tall vegetation, native coastal scrub	Polihale Beach, Kauai
	beach rock	*diversity of land type of marine origin	Halena Beach, Molokai
	sea cliffs	*steep slopes, visually dynamic	Napali Coast, Kauai Hamakua Coast, Hawaii N. Shore, Molokai
	headlands	*unique geologic formation which has dramatic form	Kaena Point, Diamond Head, Koko Head
(continued)			

TABLE 4.2 Concluded

Basic Categories	Specific Categories	Attributes Which Aid in Determining Classification as Scenic Resources	Geographic Example
	sea caves and arches	*unique geologic formation with dramatic form	Laniloa Point, Oahu Nanahoa, Lanai

Source: Pacific Urban Studies and Planning Program (PUSPP), Coastal Resources and Hazards: Identification, Analysis, and Recommendations Regarding Management Problems, Hawaii Coastal Zone Management Program, Document 8, December, 1976.

Sea cliffs and headlands having high steep slopes are visually dramatic. "Along the north side of East Molokai the sea cliffs reach a height of 3,600 feet, and those on the northeast side of Kohala mountain, on Hawaii, are as high as 1,400 feet."<sup>35</sup> Sea cliffs result from the "cutting" action by waves and as a result may exhibit several variations. Wave cut embayment may develop creating unique shoreline features such as a "horned crescent"--a distinctive concave wave-eroded ridge ending.<sup>36</sup> A wave cut notch may develop at the base of a sea cliff and this is known as a nip. These irregular coastal features enhance the scenic qualities of Hawaii's shoreline.

Sea caves and arches are unique geologic formations with dramatic form. These landforms are visually stimulating and may arouse interest and curiosity about their origins. They are often the focus of attention and favorite subjects for photographers.

Although offshore islands, seastacks and pinnacles cannot be considered as inland boundary criteria, they should not be excluded from the CZM boundary. These features represent unique works of art, the result of the natural elements of erosion. Some of the vivid names given to these features, for example "Chinaman's Hat" and "Rabbit Island", are evidence of their visual qualities and their value to the coastal scenery,

The preceding section described attributes which helped to identify coastal scenic resources. Those resource classifications presented in Table 4.2 should be considered for inclusion in the CZM boundary.

### Ecosystems

Hawaii's coastal ecosystems are valuable for many different reasons. This is apparent from the diversity of values identified for the recreation and scenic and open space elements in other sections of this chapter. The diversity of values reflects the diversity of interest in the utilization and management of Hawaii's coastal resources. With so many competing uses for our natural resources, it is easy to forget or ignore the fact that many ecosystems are extremely vulnerable and are susceptible to irreversible damage.

"The danger is that the uses which now appear to be most beneficial may ultimately be purchased by an unacceptable loss of other uses which are now poorly understood and often assumed to be 'free services' provided by the environment."<sup>37</sup>



The most limiting factor in the use of non-renewable natural resources should be the realization that extinction is forever. "There is no way that a species and its natural diversity once lost, can be restored."<sup>38</sup> The diversity of a natural gene pool is the key consideration for preservation purposes. Many advances in our quality of life have been made possible because of the diverse genetic reservoirs available in our natural environment. Disease resistant tomatoes; tall, straight, fast growing trees and numerous drugs for medicinal purposes are examples of man's use of our genetic reservoirs. "With the extinction of a species the source material for a new medicine, potential food, beverage, pesticide, ornamental, or industrial product may be lost."<sup>39</sup>

Hawaiian ecosystems are an important part of the world's genetic reservoir. The isolation of the Hawaiian Islands from major land masses provided an environment with a minimal amount of natural predators and competitors for new plant species. As new arrivals are able to establish themselves, they would move into all available space until some form of balance was restored. Once the population was brought into check, isolated colonies were sometimes developed. "With their limited gene pool and through the accumulation of the expected changes in their genetic makeup, they soon became different enough to be recognized as new varieties, species or subspecies."<sup>40</sup>

Hawaii has been especially appreciative of this important legacy; and as a result, more than two-thirds of the extinct plants in the United States are of Hawaiian origin. While it is too late to do anything about those species which are extinct, something should be done to save those that are left. The U.S. Fish and Wildlife Service proposed a list of threatened and endangered species developed by the Smithsonian Institution in the Federal Register on June 16, 1976. Of the 1,700 taxa or classifications of plant species on the list, approximately 50 percent are native to the Hawaiian Islands. This situation places a lot of pressure on the State of Hawaii to improve its batting average in natural resource management. Resource management programs, such as CZM can make a positive contribution by making every effort to assure that protective measures are taken to prevent further losses from our genetic reservoirs.

The argument being made for conservation does not exclude productive uses of the environment from consideration. Rather, it proposes that an uneven distribution of man's activities among ecosystems will preserve ecological options. Some ecosystems may be used intensively; others may need protection from a few uses and some may require protection from most uses. "Intensive uses, which carry the greatest risk of irreversible change, should be concentrated together in 'tough' ecosystems so as to keep ecological options open in more vulnerable ecosystems and

spread the risk of uncontrollable, stressful disturbances."<sup>41</sup> In other words, man's use of the environment should be related to the ecosystem's ability to resist irreversible change.

Those ecosystems which require extra protection must be identified before the strategy to preserve ecological options can be carried out. At a general level "coastal ecosystems", as used in this paper are determined by:

1. physical/chemical influence of ocean on land;
2. physical/chemical influence of land on ocean; and
3. living systems influenced by the ocean.

This broad definition requires some refinement before ecosystems which require extra protection can be identified.

This section will consider only the biological and physical functions of Hawaiian coastal ecosystems. Other ecosystem values have been identified and considered in previous sections of this paper. The values that will be discussed here include habitat (living space, breeding grounds, shelter space), buffering (storage, filtration, trapping, absorbing), and transmission (food, energy, materials). However, all coastal ecosystems having biological and physical functional value will not be included for CZM boundary consideration. The coastal ecosystems element of the boundary criteria will concentrate only on those ecosystems considered to be "critical".<sup>42</sup> "Critical" coastal ecosystems will be identified on the basis of the following considerations:

1. Scarcity;
2. Vulnerability;
3. Potential for regeneration (determination of how fragile); and
4. Potential for irreversibility.

Scarcity involves the consideration of supply of a specific geographic area. An ecosystem may be scarce on a regional, county, statewide, nationwide or a worldwide scale. While worldwide scarcity may have the highest value (for preservation), ecosystems which are scarce only on a regional basis may also merit preservation if location considerations demand it.

Vulnerability may be understood as an ecosystem's susceptibility to alteration and destruction. While vulnerable ecosystems may not be scarce in terms of absolute numbers, the rate or extent of past disturbances by man are cause for concern. This usually occurs because the ecosystem contains environmental resources which are highly valued

for particular uses. As a result, these ecosystems are altered and degraded to the point where options for other uses are foreclosed.

The potential for regeneration and the potential for irreversibility are opposite sides of the same coin. These considerations involve questions of fragility or the resiliency of a particular ecosystem. Small ecosystems are very fragile while large ones have greater potentials for recovery. The opportunity for regeneration is good if natural pathways are open for re-establishment from contiguous stock. Degradation may be irreversible, however, if no source stocks for re-introduction are available.

### Critical Coastal Ecosystems

The rationale used for identifying each of the "critical" coastal ecosystems will be provided below. Each "critical coastal ecosystem" will be used as part of the CZM inland boundary criteria.

#### 1. Perennial Streams of High Natural Quality

Perennial streams of high natural quality, including channels and adjacent soils which are saturated with water most of the year are considered to be "critical" coastal ecosystems. Streams represent Hawaii's most abundant inland water type; however, "less than 15 percent of over 350 perennial stream ecosystems still retain high natural quality."<sup>43</sup> Table 4.3 provides a list of streams which still retain high natural quality. The primary determinant for high natural quality is an abundance of native stream macroforms which is not dominated by exotic species. A study done on the effects of stream channel modification found that "by number and biomass, native species were dominant in unaltered streams, while exotic species were dominant in altered streams."<sup>44</sup> The definition of an altered stream used in this study was based on channel modifications which included the following: bottom invert, revetment, clearing and realignment, blocked channel, culverts and extended culverts. Besides stream modifications, it is also important that the stream water is not significantly diverted since maintenance on

TABLE 4.3  
HAWAIIAN STREAMS OF HIGH NATURAL QUALITY

Kauai	Oahu	Molokai	Maui	Hawaii
Awaapuhi	Heeia	Halawa	Alelele	Hakalau
Hanakapiai	Kahana	Pelekunu	Hahalawe	Honokane Iki
Hanakoa	Kahanaiki	(Kawaipaka,	Hanawi	Honolii
Hanalei	Kaluanui	Lanipuni,	Kahakuloa	Kawainui
Honopu	Koloa	Pilipililau)	Kopiliula	Kolekole
Huleia	Maunawili	Wailau	Makamakaole	Pololu
Kalalau	Waiahole	Pulena	Paakea	Umauma
Kalihiwai			Palikea	Waimanu
Kolauea			Puaaluu	Wailoa
Lumahai			Wailua	
Miliolii			E. Wailuaiki	
Nualolo			W. Wailuaiki	
Waiahuakua			Waiohinu	
Wainiha			Waiohue	

Source: U.S. Fish and Wildlife Service, Report No. FWS/OBS 78/16

some minimum flow is necessary for sustaining perennial stream ecosystems<sup>45</sup> moreover, physio-chemical properties of stream waters should not exceed standards recommended by the "208" Technical Committee on Water Quality Standards.

Streams have an important biological function; they serve as essential migratory pathways for many large diadromous stream animals. Diadromous species live and spawn in streams; however, their larvae migrate to nearshore coastal waters for development and return to the streams as juveniles. Native diadromous species include "five fishes (o'opu), two shrimps (opae), and at least one mollusk (hihiwai)."<sup>46</sup> Four of the five native fishes are on the American Fisheries Society list of threatened and endangered species.

Hawaii's native stream fauna "is particularly adapted to the rocky, precipitous, freshet-flow nature of Hawaiian streams."<sup>47</sup> Stream modifications alter their habitat, resulting in higher temperatures, Ph values, and oxygen supersaturation in comparison to unaltered streams. Stream water diversions also threaten native stream fauna. These streams may dry up intermittently or provide only shallow flow, both of which are undesirable conditions.

## 2. Coastal Wetland Ecosystems

Coastal wetland ecosystems are extremely valuable for a variety of reasons. A list of wetland values includes, among others:<sup>48</sup>

- \*1. Performance of natural biological functions, including food chain production and habitat for a variety of aquatic and terrestrial species. Estuarine wetlands often provide important larval rearing grounds for a variety of marine species, including many commercially valuable fishes.
- \*2. Sanctuaries for wildlife, including several species threatened with extinction.

3. Research areas for the study of ecological processes, educational opportunities for the study of natural history.
  4. Protection of natural drainage patterns, including levels of sedimentation, and salinity distribution.
  - \*5. Protection of adjacent lands from wave action, erosion, and storm drainage.
  6. Storage of storm and flood waters.
  7. Accumulation of nutrients.
  - \*8. Production of cash crops, including various plants and commercially valuable aquatic species (i.e., aquaculture).
  - \*9. Recreational opportunity (fishing, boating, nature appreciation, etc.).
  - \*10. Aesthetics and visual appreciation (open space and natural beauty).
- \*These values have overlapping considerations and will be discussed in other sections of this paper.

Wetlands which function as habitats for threatened or endangered species and as buffers between upland and coastal ecosystems of special interest (i.e. embayments, wave-sheltered coves, nearshore reef flats, sand beaches, and protected coral communities) should be considered for special protection. The relative scarcity of suitable habitats for threatened or endangered waterbirds makes those few remaining extremely valuable. On the other hand, wetlands which function as buffers are valuable because they help to reduce the degradation and loss of fragile aquatic ecosystems.

Coastal wetlands have been greatly diminished, in extent and number, as a result of urban growth and development. For Hawaii this situation is compounded by the fact that few habitats in Hawaii provide the necessary requirements for more than one species of waterbirds. Shorebirds and smaller

wading species require shallow waters and fertile bottoms for feeding. On the other hand, coots, gallinule and a variety of duck species in Hawaii feed in deeper water. Another problem is that some wetland areas are used only for feeding because the necessary nesting requirements are not available. All of these problems mean that many wetland areas require some form of public management to assure suitable habitats for threatened and endangered waterbirds.

Many coastal ecosystems are quite fragile and could easily be degraded if they were subjected to large quantities of sediments, fresh water, nutrients, bacteria, and other types of land drainage materials. Embayments and protective coves are sensitive because the exchange of water with the open ocean is restricted. "Because of slow flushing, pollutants introduced to embayments may be able to settle out or become available to organisms in higher concentrations."<sup>49</sup> As a result, water quality problems tend to persist even after the source of stress is relaxed. Nearshore reef flats, sand beaches, and protected coral communities are adversely affected by excessive amounts of sedimentation, freshwater flooding, nutrients, toxins, and bacteria. Discharge of these elements may bury marine life, inhibit the growth of corals, and prevent the full utilization of sandy beaches as a recreation resource.

Coastal wetlands, including wetland areas adjacent to streams, can serve as a buffer between upland activities which may create environmental stress, and the coastal ecosystems of special interest discussed above. Freshwater runoff may be detained through storage, filtration, and trapping in coastal wetland areas. By reducing the amount of runoff and delaying the flow, significant amounts of sediment, nutrients, toxic substances, and pathogenic agents may be filtered, trapped, or absorbed in the wetland area. In other words, a significant quantity of the substances which may cause environmental stress will never reach the fragile coastal ecosystems because of the buffering effect of coastal wetlands.

### 3. Native Coastal Scrub Ecosystems

The remaining examples of native coastal scrub ecosystems containing threatened or endangered coastal strand plant species are also considered to be "critical" coastal ecosystems. The strand, as defined by Fosberg in 1972, is the shoreline and the zone immediately back of the shoreline which is strongly influenced by the sea.<sup>50</sup> Here, the ecosystems are exposed to strong surge and salt spray. These ecosystems are very fragile; they are vulnerable to trampling and disturbances by vehicular traffic. Due to these human disturbances, the range of many coastal strand plant species is becoming increasingly limited.

Native coastal shrubs, grasses and herbs may be found on a variety of landform types including: sand dunes, lithified dunes, raised coral reefs, talus slopes, volcanic rock, and sheer cliffs. Table 4.4 provides examples of plants on the latest proposed threatened and endangered species list which are found in coastal ecosystems. These ecosystems, described by landform type, should be included within the coastal zone management boundary.

### 4. Estuaries of High Natural Quality

Estuaries of high natural quality, including basins and adjacent soils which are saturated with water most of the year, should be included for special management. These ecosystems are considered to be "critical" because of their high environmental and natural quality. Their intrinsic values should be perpetuated for scientific and educational purposes, genetic pools and baseline references from which degrees of man-induced changes can be measured.

The criteria for judging high natural quality are:

- a. Basins not significantly channelized, revetted, straightened, or developed as harbors;
- b. Tributary streams not significantly diverted;



TABLE 4.4

EXAMPLES OF PLANTS ON THE PROPOSED ENDANGERED SPECIES  
LIST WHICH ARE FOUND IN COASTAL ECOSYSTEMS

Ecosystem	Scientific Name	Common Name	Geographic Example
Sand dunes	<u>Sesbania</u> sp.	---	Polihale Beach, Kauai
Sand dunes	<u>Sesbania tomentosa</u>	'Ohai	Kaena Pt., Oahu
Sand dunes	<u>Gnaphalium sandwicense</u> var. <u>molokaiense</u>	---	Moomomi Beach, Molokai
Lithified dunes	<u>Solanum Nelsoni</u> Dunal	---	Moomomi Beach, Molokai
Lithified dunes	<u>Tetramalopium Rockii</u> Sherff.	---	Moomomi Beach, Molokai
Raised reef	<u>Achyranthes splendens</u> var. <u>rotundata</u> Hbd.	---	Kaena Pt., Oahu
Raised reef	<u>Santalum ellipticum</u> var. <u>littorale</u> (Hbd.) Skottsb.	Sandalwood, 'Iliahi	Goat Island, Oahu
Talus slopes	<u>Euphorbia celestroides</u> var. <u>kaenana</u> (Sherff)	'akoko	Kaena Pt., Oahu
Volcanic rocks	<u>Panicum carteri</u> Hosaka	---	Chinaman's Hat, Oahu
Sheer cliff	<u>Brighamia citrina</u> var. <u>napaliensis</u> St. John	---	Keanai Pt., Maui

(continued)

TABLE 4.4 Concluded

Ecosystem	Scientific Name	Common Name	Geographic Example
Sheer cliff	<u>Hedyotis littoralis</u> (Hbd.) Fosb	---	Kaenai Pt., Maui

Source: Interview with Dr. Derral Herbst, U.S. Fish and Wildlife Service, April, 1978

3. physiochemical properties of estuarine waters do not violate criteria of ecological health established by "208" Technical Committee on Water Quality Standards;<sup>51</sup>
4. an abundance of native as opposed to exotic fauna present.

Hawaiian estuaries function as habitats for nationally unique species, breeding and spawning habitats for commercially valuable fishes, and habitats for threatened and endangered waterbirds.<sup>52</sup> These biological and physical functions may be difficult to maintain because of the relatively small size of Hawaiian estuaries (in comparison with continental counterparts). "Because these features are small, they are vulnerable when subject to relatively low absolute levels of environmental insult; that is, the tolerance of these features is relatively low."<sup>53</sup> This places a premium on those estuaries which remain of high natural quality.

#### 5. Anchialine Pools

Another coastal water ecosystem which should be considered for coastal zone management is anchialine pools. "Anchialine pools are defined as small coastal exposures of brackish water in lava or elevated fossil reefs that have only subsurface connection to the sea (by seepage through sediments or fractures in the rock) but show tidal fluctuations."<sup>54</sup> This ecosystem should be considered "critical" for several important reasons. First, they serve as habitat for several unique and unusual shrimps, opaeula (Halocaridina rubra) and alpheid (Metabetaeus lohena).<sup>55</sup> Secondly, anchialine pools are relatively scarce because they are found nowhere else in the United States. Finally, "they are fragile environments that are easily obliterated by bulldozing and destroyed ecologically by pollution or the introduction of exotic species."<sup>56</sup>

#### 6. Exceptional Cases

Two additional considerations will be included in this section although they do not fit the eco-

systems classification. Both should be considered "critical" because of their scarcity, vulnerability, and potential for irreversibility. The first are remaining green sea turtle nesting beaches on the main islands.<sup>57</sup> Green sea turtle populations in Hawaii have been classified as "threatened" by the U.S. Fish and Wildlife Service and National Marine Fisheries and Measures. Ensuring their protection established pursuant to provisions contained in the Endangered Species Act of 1973. The continued presence of these unique ocean reptiles in Hawaiian waters is dependent on the preservation of their spawning beaches. "Populations of these turtles have been shown to return to the same breeding beaches on which they are spawned, sometimes after travelling as much as 1400 miles at sea."<sup>58</sup> The best breeding beaches are those least altered by man; therefore, those which remain should be managed for minimal disturbance.

The second consideration is brackish water lakes which defy classification because of their unique characteristics.<sup>59</sup> These bodies of water may generally be described as standing waters in well defined basins with depths greater than two meters. The water varies greatly in salinity and is usually stratified (fresh over salty). There is no surface connection to the sea and the brackish water results from the dilution of subterranean marine water and surface fresh water.<sup>60</sup> Uniqueness may pertain to size, morphology, or degree of salinity. The primary values for preservation include scientific research, education, and aesthetic enjoyment.

The preceding section has identified the critical coastal ecosystems which will be used as part of the boundary criteria. This discussion was necessary in order to make a distinction between coastal ecosystems and critical coastal ecosystems. It should be readily apparent that all coastal ecosystems will not be included within the recommended CZM boundary.

#### Coastal Hazards

As discussed in Section 2, five different coastal hazards have been identified for management concern in Hawaii's CZM law. To recapitulate, these include tsunami, storm waves, stream flooding, erosion

and subsidence.<sup>61</sup> Tsunami and stream flooding hazard areas will be identified statewide for participation in the National Flood Insurance Program (NFIP).<sup>62</sup> The NFIP also addresses storm wave hazards. Although the mapping process has not identified storm wave hazard areas specifically, authorities feel that these areas will be incorporated within the tsunami hazard boundaries. Until such time as experience proves this assumption to be false, specific identification of storm wave hazard areas may not be warranted. These maps will have the potential to reflect the most up-to-date information, and they will be available for extensive agency and public review. In addition policy (6) (c) of Hawaii's CZM law mandates compliance with the NFIP. For these reasons it is recommended that the NFIP maps be utilized to identify the inland boundary criteria with respect to tsunami, storm wave, and stream flooding hazards.

Unfortunately, the available information for the two other types of coastal hazards is not of the same quality as the NFIP maps.<sup>63</sup> The erosion and subsidence hazard elements will require more detailed treatment to identify appropriate inland boundary criteria for Hawaii's CZM program. Hopefully, the proper geographic units for management can be identified; these can then serve as tentative criteria until more detailed studies can be done.

The process of shoreline erosion occurs primarily on beach shorelines. Whereas the mean sea level has changed very little during the past 2,000 years, some beach shorelines experience seasonal changes on the order of 100 feet.<sup>64</sup> "According to Ralph Moberly (personal communication), about a third of the Hawaiian beaches showed significant net retreat during the 1963-1972 decade of observation by the Hawaii Institute of Geophysics, about a third showed neither net retreat nor net extension."<sup>65</sup>

Land based activities which affect or are affected by shoreline erosion processes will influence the CZM boundary criteria. While natural forces tend to move sand to and away from any beach, resulting in short-term equilibrium, man's activities may cause or even accelerate the process of beach retreat. This may result from sand mining or the implementation of shoreline protection schemes to protect existing structures. The management of shoreline areas with erosion problems is also necessary to regulate any new construction which may be planned in a hazard area.

The removal of sand from inland areas may cause beach retreat if the excavation is within the reach of large waves, including tsunamis. Any activity resulting from the sand mining may be subsequently filled with sand washed inland by the large waves.

"Because of the tendency toward short-term equilibrium, the removal of sand from some point on a beach face is rapidly compensated by shifts of sand from other parts of the beach, from the shallow water deposits, or from other beaches in the littoral cell."<sup>66</sup>

The sand that is removed reduces the total volume of sand in the littoral system. Beach retreat will result if the volume of sand in temporary storage cannot compensate for the sand which has been removed from the littoral system.

The primary purpose of shoreline protection schemes is to protect existing structures and other investments located near the shoreline.

"These schemes may be categorized as three major types: (1) those which inhibit direct wave attack which includes seawalls, bulkheads, revetments, and breakwaters; (2) those designed to inhibit the transport of sand by currents which include jetties built at bays and inlets, and groins; and (3) those that change the beach zone topography, such as artificial nourishment and construction of sand dunes and dikes and sand grabbers."<sup>67</sup>

The problem with many of these efforts to save existing structures is that they often end up aggravating beach retreat in the long run. This results from an inadequate understanding of long-term beach processes. The construction of seawalls, for example, is intended to protect structures which are threatened as a result of beach retreat. If the retreat was part of a long-term reversing cycle, however, the construction of a seawall interferes with the natural cycle by blocking the reaccumulation of sand the eventual rebuilding of the beach. Groins and jetties may also disrupt the littoral process by blocking down current replenishment of beaches. These problems indicate that the implementation of shoreline protection schemes must be carefully planned to avoid creating more harm than good.

Whatever schemes or approaches are selected for the protection of shoreline structure, another category of schemes for protecting structures and investments in shoreline areas involves solutions which require that the structures themselves be located and constructed to minimize the chance of damage. For example, by managing the siting of structures, damageable structures can be required to locate outside of hazardous areas. Another approach would involve relocating existing structures currently exposed to coastal hazards to safer areas. Still another approach is to require new and existing structures

to be damage resistant e.g. by requiring that the ground floor be elevated above anticipated flood levels.

Planning the location of new construction in coastal areas requires an understanding of the long-term beach trend of the area. Without this knowledge, structures may become threatened by beach retreat within their useful lifetimes. This may result in the loss of the structure or a decision to commit additional resources for the construction of protective works. Both are undesirable consequences which should be avoided. Areas which are experiencing shoreline erosion should be included within the CZM boundary. The Hawaii Water Resources Plan identifies, on small scale maps, areas susceptible to critical erosion hazards. However, without the benefit of site specific historical review and beach monitoring, a general criteria for boundary determination will have to suffice. A distance of 300 feet from the shoreline is proposed as the general criteria to assure that critically eroding beach areas are included within the CZM area.<sup>68</sup>

The subsidence hazard in the State of Hawaii is the result of (1) settling of the island as a whole, (2) downward movement of discrete blocks as a result of subsurface withdrawal of magma, (3) relative downward and outward slumping of huge blocks along the margins of the island, and (4) local small-scale collapse of lava tubes.<sup>69</sup> Subsidence caused by the withdrawal of magma and block slumping are the two major reasons for concern. These problems are restricted to the island of Hawaii because it is the only island in the Hawaiian chain with continuing volcanic activity. The other two causes of subsidence, settling of the island as a whole and collapse of lava tubes, occur on all the islands but represent relatively low risks to life and property. Therefore, these two causes of subsidence will not be considered for determinants of the boundary criteria.

Settling of discrete blocks because of magma withdrawal occurs in and near calderas and along rift zones. The subsidence at any one time may range from less than an inch to several feet. Over time, however, settling may amount to tens of feet or more. This is a problem for coastal zone management in areas where the rift zone passes under the sea. These areas are susceptible to ocean inundation if the land subsides below sea level.<sup>70</sup>

Downward and outward movement of large slump blocks have occurred historically along the southeast and southwest coastal areas of the island of Hawaii. Although this phenomenon occurs infrequently, it presents high danger to life and property when it does occur. Submergence of coastal areas is certain, and a tsunami may also be generated by the slumping action. In 1975, subsidence along the

southeastern coastline of the island generated a local tsunami which killed two persons and caused significant property damage.

The U.S. Geologic Survey has identified critical subsidence areas for the island of Hawaii.<sup>71</sup> This has been done only in a generalized manner on a small scale map. Although it provides a good indication of where the hazard areas are, field checks and more detailed analysis will be required to improve the data for management purposes.

### Economic Uses

Hawaii's CZM law recognized the need to plan for economic uses in the coastal zone which are coastal-dependent and necessary to the State's economy. Policy (5)(b) specifically identifies harbors and ports, visitor industry facilities, and energy generating facilities as coastal-dependent developments. As discussed earlier in Chapter 3, this list does not limit the definition of coastal-dependent. Instead, the inclusion of visitor industry facilities indicates that the intended definition is rather broad. That is, activities which are not physically dependent on coastal resources but would experience a loss of quality in the goods or services provided if not located in the coastal zone are also considered coastal-dependent.

Ideally, resource characteristics which describe areas suitable for coastal-dependent development should be identified to serve as CZM boundary criteria. However, it would be unrealistic to attempt this task because "coastal-dependent" is defined so broadly. The term "energy-generating facilities", for example, may pertain to biomass, geothermal, hydroelectric, ocean, solar, solid waste, wind, and fossil fuel energy facilities. Each of these may have different resource requirements; and, therefore, a wide variety of siting requirements would have to be identified. Petroleum fuel energy generating facilities which currently supply most of Hawaii's electrical energy are coastally dependent for cooling waters and proximity to fuel unloading dock facilities, however, other energy sources are still in the development stages and their facility requirements are not really known. Consequently, any definitional guideline will run the risk of excluding developments which are, on a subtle level, coastal-dependent.

One way to solve this problem is to keep the boundary criteria developed for this management concern at a broad scale. This will preserve managerial flexibility and provide the opportunity for other types of development to prove their coastal dependency on a case-by-case basis. As a minimum, areas which are targeted for resort, harbors and ports, energy generating and aquaculture development\* facilities dependent upon marine (as opposed to fresh) water resources for



intrastructural development should be included within the CZM boundary.<sup>72</sup> This may be accomplished by having areas currently zoned or general planned for these uses serve as the criteria for boundary determination purposes.<sup>73</sup> (i.e., industrial and resort).

By pursuing this strategy several worthwhile objectives may be achieved. First of all, the spirit of Hawaii's CZM law is maintained by directly addressing economic uses in the development of inland boundary criteria. This assures that the economic use of the coastal zone will be encouraged by including areas currently zoned or general planned for particular economic uses in the boundary criteria. On the other hand, managerial options are preserved because the criteria will not limit (by definition) those uses which can be considered coastal-dependent. For example, areas adjacent to the shoreline, which are general planned or zoned for industrial or resort use, are broad categories which do not specifically itemize what is considered coastal-dependent economic uses.<sup>74</sup> Finally, the individual counties will be free to recognize regional differences, area-specific advantages and disadvantages, within their jurisdiction. The counties will not be restricted by specific descriptions of areas appropriate for coastal development that apply statewide and don't allow for exceptions.

#### Summary

The criteria which are being recommended are based on the interpretation that, as a minimum, the objectives and policies for recreation, scenic and open space resources, coastal ecosystems, coastal hazards, and economic uses should be embodied in the establishment of permanent inland boundaries. The criteria which follow are being recommended for use in amending special management area boundaries. It should be stressed that this is a recommendation for a minimum boundary and that the counties may exceed the requirements in order to accommodate their own concerns. In addition, the criteria are designed to meet minimum federal requirements as specified in the "Coastal Zone Management Approval Regulations" (Section 923.31(a)(1-6)).

#### Criteria

1. Inland Boundaries Implied by Coastal Recreation Resources.
  - a. The Coastal Zone Management area shall include all perennial streams of high natural quality as identified by the U.S. Fish and Wildlife Service<sup>75</sup> and those perennial streams and channels whose quality may be restored either managerially or naturally, at reasonable cost and within a reasonable amount of time.

- b. The Coastal Zone Management Area shall include all coastal wetlands, including wetlands adjacent to streams, freshwater, mixohaline, and saline systems which serve either one or more of the following functions:
  - °Buffers between uplands and coastal ecosystems of special interest (coastal ecosystems of special interest are embayments, wave-sheltered coves, nearshore reef flats, and beaches, and protected coral communities);
  - °Areas vital to the life support of seabirds and waterbirds, particularly threatened or endangered species; and
  - °Areas serving as habitat for obligate hydrophyte plant species.
- c. The Coastal Zone Management Area shall include all natural estuaries of high natural quality, including basins and adjacent soils which are saturated with water most of the year where:
  - °Basins are not significantly channelized, revetted, straightened or developed as harbors; and
  - °Physiochemical properties of estuarine waters are not in violation of ecological health standards established by "208" Technical Committee on Water Quality Standards.<sup>76</sup>
- d. The Coastal Zone Management Area shall include all sandy beach areas including the foreshore and the backshore which are defined as follows:
  - °The foreshore consists of the sloping part of the beach between the low water level and the crest of the most seaward berm; and
  - °The backshore is the generally flat part of the beach lying between the seaward berm crest and the coastline where the coastline is the beginning of dunes, seacliff, marsh, or a manmade structure.
- e. The Coastal Zone Management Area shall include all rocky shoreline areas including seacliffs, benches and boulder beaches.

2. Inland Boundaries Implied by Coastal Scenic and Open Space Resources.

- a. The Coastal Zone Management Area shall include all water bodies within the following categories: open bays, coves, natural estuaries, lagoons, natural river mouths, natural streams/rivers.
- b. The Coastal Zone Management Area shall include features of the water/land interface including the following: basalt benches, low cliffed coasts, blowholes, beaches, coastal wetlands, undeveloped flood plains.
- c. The Coastal Zone Management Area shall include the following scenic landforms: broad valley landform, elevated reefs, sand dunes, beach rock, sea cliffs, headlands, sea caves, and arches.

3. Inland Boundaries Implied by Coastal Ecosystems.

- a. The Coastal Zone Management Area shall include all perennial streams of high natural quality as identified by the U.S. Fish and Wildlife Service<sup>77</sup> and those perennial streams and channels whose quality may be restored either managerially or naturally at reasonable cost and within a reasonable amount of time.
- b. The Coastal Zone Management Area shall include all wetlands, including wetlands adjacent to streams which function as (1) buffers between uplands and coastal ecosystems of special interest;<sup>78</sup> (2) areas vital to the life support of seabirds and waterbirds, particularly threatened or endangered species; and (3) areas serving as habitat for obligate hydrophyte plant species (same as 1b).
- c. The Coastal Zone Management Area shall include those coastal scrub ecosystems, which contain threatened or endangered plant species to include:

°Coastal scrub on backbeaches and dunes;

°Coastal scrub on lithified dunes;

°Coastal scrub on volcanic rock;

°Coastal scrub on raised reef; and

°Native grasses and herbs on backbeaches and dunes (same as 1c).

- d. The Coastal Zone Management Area shall include all natural estuaries of high natural quality, including basins and adjacent soils which are saturated with water most of the year where:

°Basins not significantly channelized, revetted, straightened or developed as harbors;

°Tributary streams not significantly diverted;

°Physiochemical properties of estuarine waters not in violation of ecological health standards established by "208" Technical Committee on Water Quality Standards.

- e. The Coastal Zone Management Area shall include all anchialine pools, brackish water lakes and turtle nesting beaches.

#### 4. Inland Boundaries Implied by Coastal Hazards

- a. The Coastal Zone Management Area shall include all tsunami inundation areas based on the 100-year recurrence frequency. (The boundary would extend inland to the highest elevation which would be flooded by a wave which has a 1% chance of occurring in any given year.)
- b. The Coastal Zone Management Area shall include all stream flooding areas based on the 100-year recurrence frequency. (The boundary would extend inland to the highest elevation which would be flooded by rainstorm which has a 1% chance of occurring in any given year.)
- c. The Coastal Zone Management Area shall include all backbeach areas extending 300 feet inland from shoreline areas identified as having critical shoreline erosion problems.
- d. The Coastal Zone Management Area shall include all storm wave inundation areas. (Assumed to be incorporated within the tsunami inundation area.)
- e. The Coastal Zone Management Area shall include all areas identified to be susceptible to shoreline subsidence.

5. Inland Boundaries Implied by Economic Uses.

- a. The Coastal Zone Management Area shall include all areas adjacent to the shoreline which are zoned and/or designated for industrial use by general or community development plans.
- b. The Coastal Zone Management Area shall include all areas adjacent to the shoreline which are zoned and/or designated for resort use by general or community development plans.
- c. The Coastal Zone Management Area shall include all areas which are targeted for use as harbors and ports in general plans, community development plans and/or functional plans.
- d. The Coastal Zone Management Area shall include all areas adjacent to the shoreline which are targeted for use as energy generating facilities in general plans, community development plans and/or functional plans.
- e. The Coastal Zone Management Area shall include all areas adjacent to the shoreline which are targeted for aquacultural use in general plans, community development plans and/or functional plans. In addition, fishponds which are suitable for restoration should also be included for this purpose.



## SECTION V

### GUIDELINES FOR IMPLEMENTING THE CRITERIA

The criteria identified in Section IV will not be useful for reviewing or amending special management area boundaries unless interpretive guidelines for their implementation are provided. Guidelines are necessary to allow consistent application of the criteria throughout the various jurisdictions. If guidelines are provided at the outset, unnecessary confusion and misunderstanding between those developing and those reviewing the boundaries may be avoided. This Section provides the necessary guidelines in the form of procedures for implementing the boundary criteria.

A checklist approach may be used as the general procedure for implementing the boundary criteria. That is, the criteria may serve as a list of attributes which help to describe the elements within a minimum CZM boundary. The site specific application of these criteria will require an item-by-item check-off to determine if any of the attributes are present in that particular location. Areas found to have the particular attributes described by the criteria should be included within the CZM boundary.

This general framework for implementation should be used for each of the sub-elements of the criteria. In those situations where the sub-elements being examined are adequately defined and the information necessary for making a boundary determination is readily available, using the criteria will be fairly simple and straightforward. In other cases, the sub-elements may require clarification and additional specificity, or the information necessary for making a determination may not be readily available.

Each sub-element of the criteria will be analyzed individually so that additional clarification may be provided if necessary, and the adequacy of available information sources may be determined. For those situations where the available information is inadequate, guidelines will be provided to help overcome difficulties which may be encountered as a result.

The boundary criteria consists of five major categories and their sub-elements. These were obtained through an interpretation of the objectives and policies of Act 188, SLH 1977. When implementing the boundary criteria, each category should be analyzed and applied separately so that individual maps of each category can be made. The primary advantage for doing this is to retain accountability when the boundary is finally developed. The county management authority, the state lead agency, and even the general public will benefit if this

procedure is followed.<sup>1</sup> This is the easiest way to ensure that the reason for including a site-specific area within the boundary can be determined.

After each category of the boundary criteria is analyzed and applied, there will be five single-element maps, one for each category. These maps will then be overlayed to create a composite map which will delineate the CZM boundary. The composite map will reflect only the most inland extent of the elements being mapped.

### Criterion 1

Criterion One, as presented in Section IV, identifies inland boundaries implied by coastal recreation. Sub-element (a) reads as follows:

The Coastal Zone Management area shall include all perennial streams and channels of high natural quality as identified by the U.S. Fish and Wildlife Service,<sup>2</sup> and those perennial streams and channels whose quality may be restored either managerially or naturally, at reasonable cost and within a reasonable amount of time.

The most critical segment of the information necessary to implement criterion 1(a) has already been developed. Table 4.3, from the preceding section, provides a list of perennial streams which have been determined to be of high natural quality by the U.S. Fish and Wildlife Service. This list can be applied directly, without modification, to implement criterion 1(a).

A second concern expressed by criterion 1(a) involves those perennial streams and channels whose quality may be restored either managerially or naturally, at reasonable cost and within a reasonable amount of time. This consideration presents several difficulties for implementation because some process will have to be established to determine: (1) the level to which quality should be restored; (2) reasonable cost; and (3) reasonable amount of time. One way that this could be handled would be to establish a committee to evaluate and decide on nominations submitted for consideration.<sup>3</sup> However, no such process exists at this time.

Sub-element 1(b) reads as follows:

The Coastal Zone Management Area shall include all coastal wetlands, including wetlands



adjacent to streams, freshwater, mixohaline, and saline systems which serves either one or more of the following functions:

- \* Buffers between uplands and coastal ecosystems of special interest; (coastal ecosystems of special interest are embayments, wave-sheltered coves, near-shore reef flats, sand beaches, and protected coral communities); and
- \* Areas vital to the life support of seabirds and waterbirds, particularly threatened or endangered species; and
- \* Areas serving as habitat for obligate hydrophyte plant species.

Three recently completed studies will provide the most up-to-date information to partially fulfill the implementation needs of criterion 1(b). One of them is a study done for the U.S. Army Corps of Engineers by Ahuimanu Productions (Robert J. Shallenberger, Ph.D., principal investigator), entitled "An Ornithological Survey of Hawaiian Wetlands".<sup>4</sup> The second report is a draft of the "Hawaiian Wetlands Recovery Plan" done for the U.S. Fish and Wildlife Services.<sup>5</sup> The third report, prepared for the U.S. Army Corps of Engineers by Margaret Elliott and Erin Marie Hall, is entitled, "Wetlands and Wetland Vegetation of Hawaii."<sup>6</sup> These reports identify areas vital to the life support of seabirds and waterbirds as well as areas serving as habitat for obligate hydrophyte plant species.

Delineating wetland areas which serve as buffers between uplands and coastal ecosystems of special interest will be more difficult because it involves several steps. First of all, coastal ecosystems of special interest, including embayments and wave-sheltered coves, near-shore reef flats, anchialine pools, beaches, and protected coral communities, may be identified by the "208" Technical Committee on Water Quality Standards. Maps of these areas are presented in a Department of Health report entitled, "An Ecosystem Approach to Water Quality Standards."<sup>7</sup> The second step will involve identifying wetland areas which exist in relation to those coastal ecosystems of special interest. These wetland areas may be identified by the three reports cited above.

However, wetlands adjacent to streams will have to be identified through a totally different process because these areas have not previously been identified specifically. This information may be

obtained by interpreting U.S. Soil Conservation Service soil survey maps,<sup>8</sup> using soil characteristics such as the very poorly drained and somewhat poorly drained soils to make this determination.

Criterion 1(c) is stated as follows:

The Coastal Zone Management Area shall include all natural estuaries of high natural quality, including basins and adjacent soils which are saturated with water most of the year where:

- \* Basins are not significantly channelized, revetted, straightened or developed as harbors;
- \* Tributary streams are not significantly diverted; and
- \* Physicochemical properties of estuarine waters are not in violation of ecological health standards established by "208" Technical Committee on Water Quality Standards.<sup>9</sup>

Maps presented in a report entitled, "An Ecosystem Approach to Water Quality Standards" identify existing natural estuaries.<sup>10</sup> Those of high natural quality are tentatively identified pending the acquisition of additional baseline water quality monitoring data. The procedure for identifying the adjacent soils which are saturated with water most of the year will be the same as the one used for identifying wetlands adjacent to streams, criterion 1(b).

Criterion 1(d), dealing with sandy beach areas, reads as follows:

The Coastal Zone Management Area shall include all sandy beach areas including the foreshore and the backshore which are defined as follows:

- \* The foreshore consists of the sloping part of the beach between the low water level and the crest of the most seaward berm; and
- \* The backshore is the generally flat part of the beach lying between the seaward berm crest and the coast line where the coastline is the

beginning of dunes, seacliff, marsh,  
or a manmade structure.

Several documents may be used as sources for identifying sandy beach areas. A review draft of the "Hawaii Water Resources Plan" published by the Hawaii Water Resources Regional Study provides general maps of sandy beach areas.<sup>11</sup> However, these maps are not drawn to a large scale and may not be detailed enough for boundary determination purposes. Soil survey maps published by the Soil Conservation Service may be used if more detailed information is required.

Criterion 1(e) reads as follows:

The Coastal Zone Management Area shall include  
all rocky shoreline areas including seacliffs,  
benches and boulder beaches.

Rocky shoreline areas have been generally delineated on maps in "An Ecosystem Approach to Water Quality Standards".<sup>12</sup> As in criterion 1(d), soil survey maps published by the U.S. Soil Conservation Service, may be used if more detailed information is required.

#### Criterion 2

Criterion Two deals with inland boundaries implied by coastal scenic and open space resources. Sub-element 2(a) reads as follows:

The Coastal Zone Management Area shall include  
all water bodies within the following categories:  
open bays, coves, natural estuaries, natural  
river mouths, and natural streams/rivers.

Maps which specifically identify these particular water bodies may be found in "An Ecosystem Approach to Water Quality Standards".<sup>13</sup> Inasmuch as the criteria have been developed for designating an inland boundary, this sub-element involves land area which lies adjacent to the specified water bodies.

Criterion 2(b) reads as follows:

The Coastal Zone Management Area shall include  
characteristics of the water/land interface  
including the following: basalt benches,  
low cliffed coasts, blow holes, beachaes,  
coastal wetlands, and undeveloped flood plains.

Information necessary to implement this criterion will have to be gathered from a variety of sources. Many of these reports have been previously mentioned for other criteria requirements including: (1) soil survey maps published by the U.S. Soil Conservation Service; (2) "Hawaii Water Resources Plan;" (3) "An Ecosystem Approach to Water Quality Standards; and (4) "Wetlands and Wetland Vegetation of Hawaii." In addition, the "Atlas of Hawaii," published by the University Press,<sup>14</sup> may also be of some help.

Criterion 2(c) reads as follows:

The Coastal Zone Management Area shall include the following scenic landforms: broad valley landform, elevated reefs, sand dunes, beach rock, sea cliffs, headlands, sea caves, and arches.

Most of the information required by Criterion 2(c) can be found in Volcanoes in the Sea.<sup>15</sup> The book contains geologic maps for each of the major islands as well as written description of their regional geology. While the maps in the text may be too small for detailed use, larger scale working maps are available at the Hawaii Institute of Geophysics, University of Hawaii. For some of the required elements, sea caves and arches for example, statewide comprehensive data may not be available. In these situations, the site specific examples provided by Volcanoes in the Sea will have to be supplemented by input from local residents about regional characteristics which they may be familiar with.

The broad valley landform presents a very difficult problem for inclusion within the CZM boundary. How far inland does one draw the CZM boundary based on this scenic and open space resource? All the way back to the head of the valley? Three-fourths of the valley? One-half of the valley? Many people would agree that including all of the valley based on the scenic and open space element would be unreasonable; but there would also be little agreement on how much less than the whole to designate. Realizing that this is a difficult problem to solve, it is proposed that a line be drawn from the top of the two ridges (which define the valley) down to the shoreline and across the mouth of the valley. In this way at least the visual "face" of the valley can be assured of coastal zone management.

### Criterion 3

Criterion Three is intended to identify inland boundaries implied by coastal ecosystems. This criterion contains several sub-elements which duplicate concerns expressed in Criterion One.

Therefore, sub-element 3(a) (perennial streams of high natural quality), 3(b) (coastal wetlands), and 3(d) (estuaries of high natural quality) will not be repeated in this section. The remaining elements will be discussed below.

Sub-element 3(c) reads as follows:

The Coastal Zone Management Area shall include those coastal scrub ecosystems, which contain threatened or endangered native plant species to include:

- \* Coastal scrub on backbeaches and dunes;
- \* Coastal scrub on lithified dunes;
- \* Coastal scrub on volcanic rock;
- \* Coastal scrub on raised reef; and
- \* Native grasses and herbs on backbeaches and dunes.

The information available for this criterion is quite scarce. Although the endangered species list is available, little work has been done to inventory the site specific locations where they still exist. However, work that is currently underway will provide the necessary information very shortly. The U.S. Fish and Wildlife Service is presently undertaking studies of known distributions of threatened and endangered plant species and this work should be completed in about a year.<sup>16</sup> Some preliminary information may be obtained by contacting Dr. Derral Herbst, of the U.S. Fish and Wildlife Service, who is in charge of the endangered plant species.

Criterion 3(e) reads as follows:

The Coastal Zone Management Area shall include all anchialine pools, brackish water lakes, and turtle nesting beaches.

Information concerning anchialine pools and brackish water lakes are provided on maps in the "208" Technical Committee Report on Water Quality Standards for the Department of Health.<sup>17</sup> These small scale maps will indicate general locations; however, this information may be augmented by: (1) interpreting aerial photographs; (2) interpreting soil survey maps; or (3) conducting field surveys.

The information on sea turtle nesting beaches on the inhabited islands is not well documented. Three beaches, Halawa Beach (Molokai), Orr's Beach (Hawaii), and Punaluu Beach (Hawaii) have been identified as possible nesting sites of one species of sea turtle, the Hawks Bill. Additional public input should be solicited to supplement and verify any available information.

#### Criterion 4

Criterion Four identifies inland boundaries implied by coastal hazards. Three of the sub-elements for this criterion will utilize the same information source for implementation purposes. These will be discussed at the same time. Sub-elements 4(a), 4(b), and 4(d) read as follows:

- (a) The Coastal Zone Management Area shall include all tsunami inundation areas based on the 100-year recurrence frequency. (The boundary would reflect the highest elevation which is flooded by a wave which has a 1% chance of occurring in any given year.)
- (b) The Coastal Zone Management Area shall include all stream flooding areas based on the 100-year recurrence frequency. (The boundary would reflect the highest elevation which is flooded by rainstorm which has a 1% chance of occurring in any given year.)
- (d) The Coastal Zone Management Area shall include all storm wave inundation areas. (Assumed to be incorporated within the tsunami inundation area.)

Both the tsunami and stream flooding hazard areas will be identified statewide for participation in the National Flood Insurance Program (NFIP). The hazard areas will be drawn on large scale maps (1:1,000) and will be based on the 100-year recurrence frequency. The information provided on these maps will be the most comprehensive and up-to-date available. Maps for the City and County of Honolulu have already been prepared; those for the Neighbor Island counties shall be available sometime in the fall of 1978.<sup>19</sup>

As stated previously in this chapter, storm wave hazard areas will not be identified specifically. However, the counties or DPED may still wish to specifically address this criterion. As an alternative, historical storm wave run-up elevations may be used in combi-

nation with maps which identify areas susceptible to storm wave hazards. These maps are provided in the Hawaii Water Resources Plan.<sup>20</sup>

Sub-element 4(c) reads as follows:

The Coastal Zone Management Area shall include all back beach areas extending 300 feet inland from shoreline areas identified as having critical shoreline erosion problems.

The Hawaii Water Resources Plan identifies, on small scale maps, areas susceptible to critical erosion hazards.<sup>21</sup> However, without the benefit of site specific historical review and beach monitoring studies, it is not possible to determine the inland extent of the erosion hazard from these maps. In lieu of these studies, a uniform distance of 300 feet from the shoreline of the critically eroding beachfronts identified in the Hawaii Water Resources Plan, is proposed as an interim boundary. The arbitrary choice of 300 feet is based on historical evidence. "Surveys made of the Kalama Beach Park in 1912 and 1961 showed that the shoreline receded 300 feet during the 49-year period."<sup>22</sup> This is an extreme example but it indicates the extent of erosion that may be possible in other areas during a comparable time period.

Criterion 4(e) reads as follows:

The Coastal Zone Management Area shall include all areas identified to be susceptible to shoreline subsidence. (The only area in the state identified as having a coastal subsidence problem is the southeast coastline of the island of Hawaii.

While all of the islands may experience shoreline subsidence, only the island of Hawaii is considered to have relatively high risks to life and property. This is because Hawaii is the only island with current volcanic activity. The U.S. Geologic Survey has identified areas subject to relatively high risk from subsidence for the island of Hawaii.<sup>23</sup> Although presented in a generalized manner on a small scale map, a good indication is provided of where the hazard areas are located. More detailed field analysis by trained geologists, however, may be required for management purposes. In the meantime, a uniform inland distance may have to suffice.

#### Criterion 5

Criterion Five will identify inland boundaries implied by economic uses. Nearly all of the sub-elements for this criterion will

use county zoning, community development plans and/or general plan maps as the basis for boundary determination.<sup>24</sup> Four of the sub-elements, 5(b), 5(c), 5(d) and 5(e), in addition call for the use of State functional plans. Presently, no functional plans have yet been officially adopted, however, proposed functional plans have been developed for tourism<sup>25</sup> and harbor and port facilities.<sup>26</sup> Both of the documents contain maps delineating potential areas for future development facilities. Finally, the Hawaii Water Resources Plan may serve as a source to identify fishponds which are suitable for restoration.

The preceding discussion indicates that there is adequate information available for the counties to meet the requirements of most, if not all, of the criteria. All in all there is enough information available to make a legitimate effort at meeting the boundary criteria developed in Section IV.<sup>27</sup> Table 5.1 summarizes and links all of the sources identified earlier in the section with the appropriate criteria.

The sixth and final sections will implement the criteria by developing a geographic specific example. This will provide an opportunity for discussing the implications of the criteria on the new boundary in comparison to the existing SMA boundary. Differences may then be analyzed to identify possible advantages and disadvantages of the proposed criteria.



TABLE 5.1

## SUMMARY OF SOURCES FOR IMPLEMENTING THE BOUNDARY CRITERIA

Boundary Criteria	Sources
1a	U. S. Fish and Wildlife Service, "Statewide Inventory of Hawaiian Streams Including Survey of Habitat and Associated Biota," Report No. FWS/OBS-78/16.
1b	<p>Ahuimanu Productions (Robert Shallenberger, Ph.D., principal investigator), "An Ornithological Survey of Hawaiian Wetlands," Volumes I and II, U.S. Army Engineer District, Honolulu, December 1977.</p> <p>U.S. Fish and Wildlife Service, "Hawaiian Wetlands Recovery Plan," (draft), Hawaiian Waterbird Recovery Team, Honolulu, 1977.</p> <p>Margaret E. Elliott and Erin Marie Hall, "Wetlands and Wetland Vegetation of Hawaii," prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, September 1977.</p> <p>208 Technical Committee on Water Quality Standards, "An Ecosystem Approach to Water Quality Standards," Department of Health, December 1, 1977.</p> <p>United States Department of Agriculture Soil Conservation Service in cooperation with the University of Hawaii Agricultural Experiment Station, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972. (Soil Survey for the Island of Hawaii, State of Hawaii, is presented in a separate volume issued in December 1973.)</p>
1c	208 Technical Committee on Water Quality Standards, "An Ecosystem Approach to Water Quality Standards," Department of Health, December 1, 1977.
1d	Hawaii Water Resources Regional Study, "Hawaii Water Resources Plan," reveiw draft, Honolulu, April 1977.

TABLE 5.1 (continued)

Boundary Criteria	Sources
1e	<p>United States Department of Agriculture Soil Conservation Service in cooperation with the University of Hawaii Agriculture Experiment Station, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972. (Soil Survey for the Island of Hawaii, State of Hawaii, is presented in a separate volume issued in December 1973.)</p> <p>208 Technical Committee on Water Quality Standards, "An Ecosystem Approach to Water Quality Standards," Department of Health, December 1977.</p> <p>United States Department of Agriculture Soil Conservation Service in cooperation with the University of Hawaii Agriculture Experiment Station, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972. (Soil Survey for the Island of Hawaii, State of Hawaii, is presented in a separate volume issued in December 1973.)</p>
2a	<p>208 Technical Committee on Water Quality Standards, "An Ecosystem Approach to Water Quality Standards," Department of Health, December 1977.</p>
2b	<p>United States Department of Agriculture Soil Conservation Service in cooperation with the University of Hawaii Agriculture Experiment Station, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972. (Soil Survey for the Island of Hawaii, State of Hawaii, is presented in a separate volume issued in December 1973.)</p> <p>Hawaii Water Resources Regional Study, "Hawaii Water Resources Plan," review draft, Honolulu, April 1977.</p> <p>208 Technical Committee on Water Quality Standards, "An Ecosystem Approach to Water Quality Standards," Department of Health, December 1977.</p> <p>Margaret E. Elliott and Erin Marie Hall, "Wetlands and Wetland Vegetation of Hawaii," prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, September 1977.</p>

TABLE 5.1 (continued)

Boundary Criteria	Sources
Atlas of Hawaii	
2c	Macdonald, Gordon A., and Abbott, Agatin T., <u>Volcanoes in the Sea</u> , The Geology of Hawaii, The University Press of Hawaii, Honolulu 1970.
3a	Same as 1a
3b	Same as 1b
3d	Same as 1c
3c	Personal communication with Dr. Derral Herbst of the U.S. Fish and Wildlife Service.
3e	208 Technical Committee on Water Quality Standards, "An Ecosystem Approach to Water Quality Standards," Department of Health, December 1, 1977.
	United States Department of Agriculture Soil Conservation Service in cooperation with the University of Hawaii Agricultural Experiment Station, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972. (Soil Survey for the Island of Hawaii, State of Hawaii, is presented in a separate volume issued in December 1973.)
4a	National Flood Program (NFIP) hazard maps.
4b	Same as 4a
4d	Same as 4a
4c	Hawaii Water Resources Regional Study, "Hawaii Water Resources Plan," review draft, Honolulu, April 1977.
4e	D.R. Mullineaux and D.W. Peterson (1974): Volcanic Hazards on the Island of Hawaii, U.S. Geological Survey Open-file report 74-239.

TABLE 5.1 (concluded)

Boundary Criteria	Sources
5a	County zoning and/or general plan maps.*
5b	Same as 5a
5c	County general plans and/or State functional plans (i.e., harbors master plan).
5d	County general plans and/or functional plans.
5e	County general plans and/or functional plans.
	Hawaii Water Resources Regional Study, "Hawaii Water Resources Plan," review draft, Honolulu, April 1977.

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\* For those counties where the general plan is strictly a policy document, another map may have to be substituted for the general plan. In the case of the City and County of Honolulu, for example, Detailed Land Use Maps (DLUMs) should be inserted in place of the general plan.





## SECTION VI

### APPLYING THE CRITERIA

The task of selecting a specific geographic area to illustrate how the boundary criteria may be applied is not overly complicated. However, some basic requirements must be met to ensure that the geographic area selected will serve as a useful example. Some of these considerations are listed below:

- 1) Time limitations constrain the choice to those areas for which data is readily available.
- 2) The area selected should not be homogeneous in order to represent the range of situations to be confronted by those who must set the CZM boundaries. For example, the area should be neither totally urbanized nor a complete wilderness area. Diversity is necessary to provide an opportunity to discuss most, if not all, of the elements in Hawaii's CZM law.
- 3) The area selected should be such that land uses have the potential to cause direct and significant impacts on coastal waters, to be consistent with the Federal law.

The Kaneohe Bay region was selected as the geographic area to serve as the site-specific example for implementing the boundary criteria. A close look at the region will indicate that it meets all of the considerations listed above.

The Kaneohe Bay region has well defined geographic boundaries which have been described as follows:

The windward watersheds of the island of Oahu that drain northeasterly to Kaneohe Bay are separated from the leeward watersheds to the southwest by the precipitous Koolau Range, whose crests approach 3,000 feet in altitude. They are separated from the Kahana and Kaaawa Valleys to the northwest by the equally precipitous Puu Ohulehule ridge, and from the Maunawili drainage area to the southeast by the less precipitous but still steep ridge extending toward Mokapu Peninsula. The ridges between the valleys are much less pronounced than the boundary ridges of the region.<sup>1</sup>

Figures 6.1 and 6.2 provide a general and specific view of the region.

The first consideration, availability of data, is readily met. The Kaneohe Bay region is one of the more intensely studied areas in the State. Recently, the U.S. Army Corps of Engineers completed its Kaneohe Bay Urban Water Resources Study which examines future urban development and its potential environmental impact on the Kaneohe watershed.<sup>2</sup> In an earlier study the Hawaii Environmental Simulation Laboratory, University of Hawaii also examined the impact of future development in the Kaneohe watershed through a series of alternative scenarios.<sup>3</sup> In addition to these studies, the Hawaii Institute of Marine Biology which maintains research facilities on Moku o Loe Island (Coconut Island), has published a number of scientific studies on the marine environment. Some of these studies address the impacts of landward activities resulting in soil runoff and sedimentation in the bay.<sup>4</sup> Numerous other graduate research studies are also available as data sources at the University of Hawaii.

Kaneohe has evolved from a rural/agricultural community to become a suburb of Honolulu. However, other portions of the bay region remain in agricultural use and still retain their rural character. This variety of characteristics is consistent with the second consideration. Furthermore, zoning and DLUM designations for industrial and resort use provide the potential for additional variety in the future.

Kaneohe also meets the requirements of the third consideration. Ecological changes in Kaneohe Bay are directly attributable to land based activities which have occurred in the region. Two primary reasons for the ecological changes in the bay have been "discharge to the waters of sediments and of sewage effluents."<sup>5</sup> Continuing urbanization of the region will surely have additional impacts on the water quality of the bay.

For all of the reasons cited above, the Kaneohe Bay region will serve as the geographic-specific example for implementing the boundary criteria. In addition:

Although some of the particular ecological changes that are occurring in Kaneohe Bay are peculiar to the Kaneohe region, similar problems associated with changes in coastal water quality resulting from urbanization are common throughout Hawaii and in other coastal areas.<sup>6</sup>

For this reason, the Kaneohe Bay region should serve as a very useful example for implementing the boundary criteria.



As stated in Section 5, a checklist approach will be used as the general procedure for implementing the boundary criteria. Each sub-element of the criteria will be evaluated to determine if any of the attributes listed are present in the Kaneohe Bay region. If any of the sub-elements are present, they will be reflected in the maps prepared for each of the five major categories of the criteria. All of the maps will be described individually so that an understanding of their component parts can be gained.

### Coastal Recreation

The map for coastal recreation resources (Plate 1) includes all perennial streams of high natural quality as identified by the U.S. Fish and Wildlife Service.<sup>7</sup> Only two streams within the Kaneohe Bay region fit this description; they are Waiahole Stream and Heeia Stream.

Wetlands included on the recreation map serve either one of three functions. First of all, wetlands may serve as buffers between uplands and coastal ecosystems of special interest. Kaneohe Bay, in its entirety, is considered a coastal ecosystem of special interest. Kaneohe Bay exhibits the following characteristics of a coastal ecosystem of special interest: it is an embayment, it has nearshore reef flats, sand beaches, and protected coral communities.<sup>8</sup> Therefore, all of the wetland areas within the region have been included on the map.

Wetlands adjacent to streams were identified by interpreting soil survey maps. The following soil classifications were used as determining factors for identifying wetlands adjacent to streams:

- 1) Marsh - "Marsh (MZ) consists of wet, periodically flooded areas covered dominantly with grasses and bulrushes or other herbaceous plants. It occurs as small, low-lying areas along the coastal plains. Water stands on the surface, but marsh vegetation thrives. The water is fresh or brackish, depending on proximity to the ocean."<sup>9</sup>
- 2) Hanalei silty clay, 0 to 2 percent slopes (HuA)-  
"This soil is on stream bottoms and flood plains."  
Permeability is moderate. Runoff is very slow, and the erosion hazard is no more than slight."  
"Flooding is a hazard."<sup>10</sup>

- 3) Hanalei silty clay, 2 to 6 percent slopes (HuB) - "On this soil, runoff is slow and the erosion hazard is slight."<sup>11</sup>
- 4) Hanalei stony silty clay, 2 to 6 percent slopes (HoB) - "This soil has a profile like that of Hanalei silty clay, 0 to 2 percent slopes, except that it is stony. Runoff is slow, and the erosion hazard is slight."<sup>12</sup>
- 5) Lolekaa silty clay, 25 to 40 percent slopes (LoE)- "This soil occurs along drainageways and along fans adjacent to the Koolau Range. Runoff is medium to rapid, and the erosion hazard is moderate to severe."<sup>13</sup>
- 6) Pearl Harbor clay (Ph) - "This soil is on low coastal plains adjacent to the ocean. It is level or nearly level." "Permeability is very slow. Runoff is very slow to ponded and the erosion hazard is no more than slight."<sup>14</sup>
- 7) Tropaequepts (TR) - "Tropaequepts (TR) are poorly drained soils that are periodically flooded by irrigation in order to grow crops that thrive in water. They occur as nearly level flood plains on the islands of Oahu and Maui. Elevations range from sea level to 200 feet."<sup>15</sup>

Wetlands serving other functions, such as life support of seabirds and waterbirds and habitat for obligate hydrophyte plant species, were identified through other means. Two wetland areas in the Kaneohe Bay region are considered to be vital to the life support of seabirds and waterbirds.<sup>16</sup> The Heeia Marsh and Nuupia Pond area have been identified as valuable habitats for threatened and endangered waterbirds and seabirds. Heeia is considered valuable for coots, gallinule and shorebirds. The Nuupia Pond area provides habitat for the Hawaiian Stilt as well as the Cattle Egret, Migrating Pintails, Shovellers, Scamps, Buffleheads, and Black-Crowned Night Heron.<sup>17</sup>

Other wetland areas, which may overlap with those already identified for other purposes, may be identified as habitat for obligate hydrophyte plant species. Four areas in the Kaneohe Bay region have been identified for this purpose. The four, as described in Wetlands and Wetland Vegetation of Hawaii by Elliott and Hall,<sup>18</sup> includes the following:

- 1) Waihee Marsh - near Kahaluu, 2) Heeia - previously identified,

3) Kawa Stream Marsh area, and 4) Nuupia Pond area - previously identified.

Criterion 1(c) from Section IV will not have any influence on the boundary for the Kaneohe Bay region because there are no natural estuaries of high natural quality in the area. The two estuaries located in the region are considered to be developed estuaries.<sup>19</sup>

Several sandy beach areas have been identified in the Kaneohe Bay region in two general locations. These are at Kualoa Point and Mokapu Peninsula. Sandy beach areas were identified by interpreting soil survey maps. The two soil classifications used to make this determination are described as follows:

- 1) Beaches (BS) - "Beaches (BS) occur as sandy, gravelly, or cobbly areas on all the islands in the survey areas." "The beaches consist mainly of light-colored sands derived from coral and seashells. A few of the beaches, however, are dark colored because their sands are from basalt and andesite."<sup>20</sup>
- 2) Jaucas sand, 0 to 15 percent slopes (JAC) - "The slope range of this soil is 0 to 15 percent, but in most places the slope does not exceed 7 percent. Included in mapping were narrow strips of beaches and areas of Pulehu, Mokuleia, and Keaau soils."<sup>21</sup>

The final element included on the coastal recreation map is rocky shoreline areas. These areas were determined by interpreting soil survey maps. The soil classification used in making this determination is described as follows:

- 1) Rock Land (rRK) - Rock land (rRK) is made up of areas where exposed rock covers 25 to 90 percent of the surface. It occurs on all five islands. The rock outcrops and very shallow soils are the main characteristics. The rock outcrops are mainly basalt and andesite. This land type is nearly level to very steep. Elevations range from nearly sea level to more than 6,000 feet.<sup>22</sup>

### Coastal Scenic and Open Space Resources

Plate Two identifies coastal scenic and open space resources. The entire shoreline within the bay is included as a coastal scenic resource. Other characteristics of the water/land interface which identify coastal scenic and open space resources within the Kaneohe Bay region include: basalt benches, low cliffed coasts, beaches, coastal wetlands, and undeveloped flood plains.

Basalt benches, low cliffed coasts, beaches, and undeveloped flood plains have all been identified by interpreting soil survey maps. As was done for the coastal recreation map, rocky shoreline element, basalt benches and low cliffed coasts are determined by the rock land (rRK) soil classification. Similarly, the beach sub-element for scenic and open space resources is the same area as identified in the coastal recreation map. Undeveloped flood plains and coastal wetland areas overlap. The two elements are the same as the wetlands element identified in the coastal recreation map.

The final scenic and open space element identified on Plate 2 is Ulupau Head on Mokapu Peninsula. The bounds of this landform were obtained from a soil survey of the Kaneohe Bay region.

### Coastal Ecosystem

All of the elements identified on the map of coastal ecosystems (Plate 3) have been previously identified on the coastal recreation map. These elements include: 1) perennial streams of high natural quality, and 2) wetland areas, including wetlands adjacent to streams. The other sub-elements of the coastal ecosystem criteria are not present in the Kaneohe Bay region. These include: 1) coastal scrub ecosystems, 2) natural estuaries, and 3) anchialine pools.

### Coastal Hazards

The coastal hazards map (Plate 4) utilizes the National Flood Insurance Program maps to delineate the tsunami and stream flooding hazard areas based on the 100-year recurrence frequency. In addition, two areas identified as having critical shoreline erosion problems have been included.<sup>23</sup> These two areas are located on Mokapu Peninsula and at Kualoa Point. Shoreline subsidence is not a coastal hazard for the Kaneohe Bay region.

### Economic Importance

Areas important for economic uses are identified in Plate 5. The areas identified on this map have been designated for one of the following characteristics: 1) lands adjacent to the shoreline which have Detailed Land Use Map (DLUM) or zoning designations for industrial use; 2) lands adjacent to the shoreline which have DLUM or zoning designations for resort use; and 3) fishponds which have been identified as being suitable for restoration.

The sixth and final map, Plate 6, compares the existing SMA boundary with a composite of the five major characteristics previously described on the other maps. This comparison indicates that if the proposed boundary criteria are utilized, they may significantly shift the SMA boundary.

### A Comparison of Boundaries

There are a number of major differences between the boundaries as they now exist and under the proposed criteria. The existing SMA boundary follows the highway nearest the coastline in many areas of the Kaneohe Bay region. Major exceptions to this generalization are the Heeia marsh area and Mokapu peninsula. In addition, the boundary extends beyond the coastal highway where stream flooding in the coastal area is a problem. Therefore, for most of the Kaneohe Bay region, the existing SMA boundary does not extend very far inland.

The proposed criteria would include more land area within the Kaneohe Bay region in the amended SMAs. The criteria which are responsible for those additions are those which include wetlands adjacent to streams. These include the stream channels and adjacent soils which are saturated with water most of the year. This is especially vital in upland areas which are adjacent to coastal ecosystems of special interest as described in Section 4.

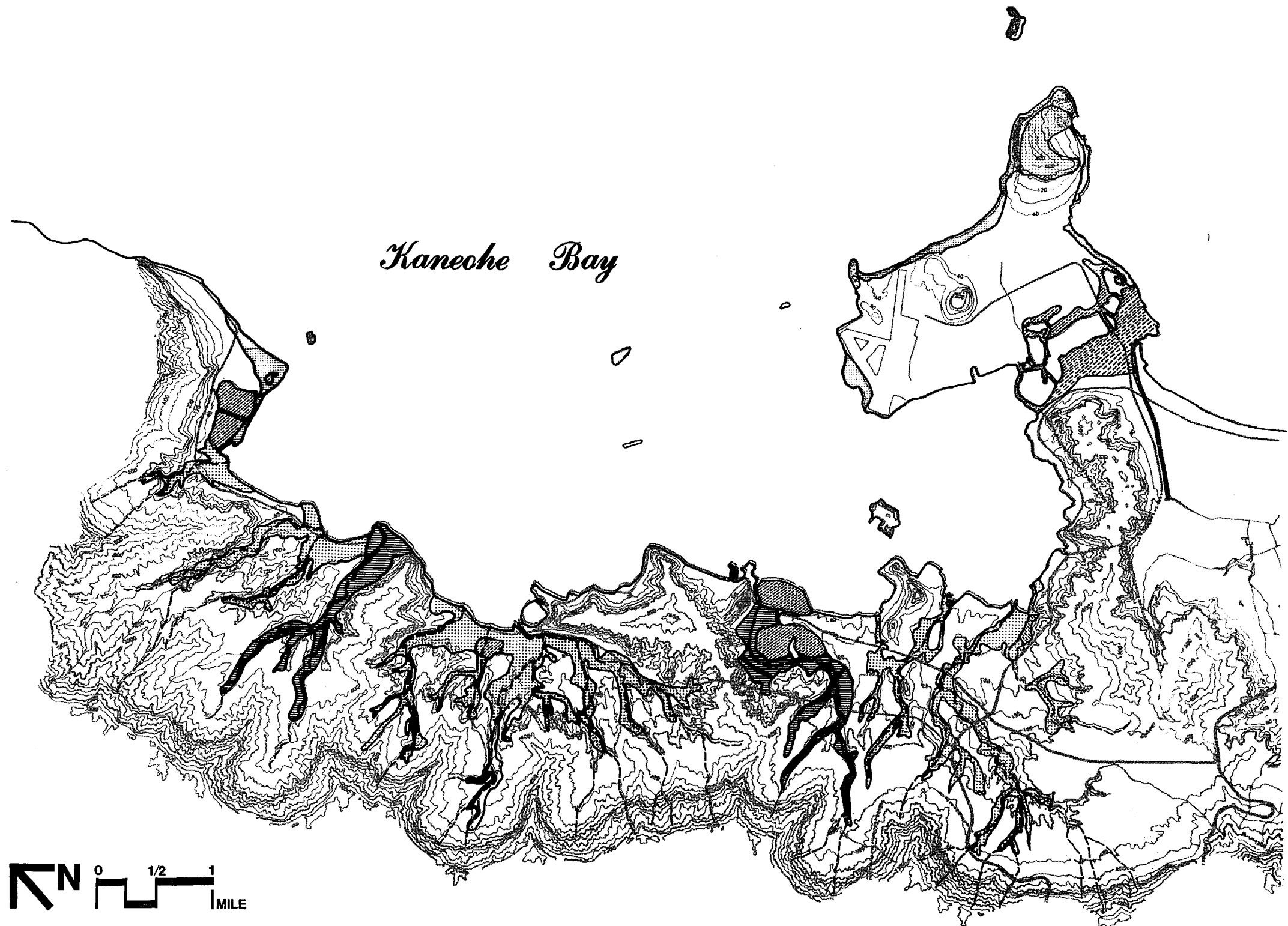
Another major difference is the Mokapu peninsula area. While the present SMA boundary encompasses the entire peninsula, the proposed criteria can justify only a small fraction of that area for the amended boundaries. Much of the land area on the peninsula has been significantly altered (from natural conditions) or has been already developed. The criteria developed in this study excludes the developed area within the SMA boundary as it is now defined.

Other areas, particularly between Kahaluu and Heeia and Kaneohe town and Mokapu peninsula, have not been affected by the proposed






boundary criteria. In these areas the existing SMA extends beyond the land area of the amended boundary. For all areas in this situation, it is recommended that the amended boundary extend a minimum of one hundred yards inland from the shoreline. This provision remains a requirement of the Hawaii coastal zone management law.

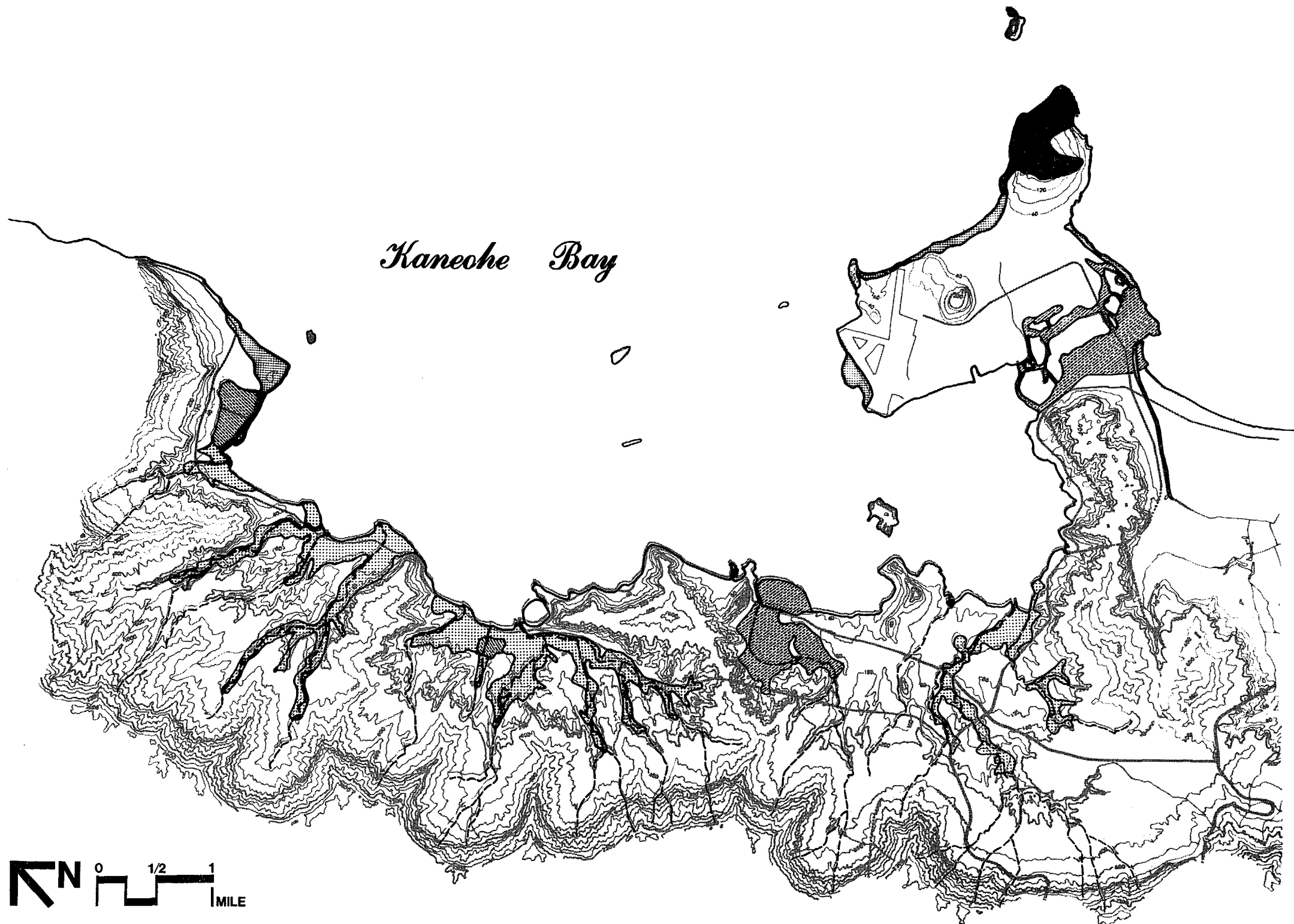
If anything, the application of the boundary criteria to the Kaneohe Bay region demonstrates that they can be implemented. In this particular example, the amended boundary would extend much farther inland than the existing SMA. However, indications are that this may not be true for all geographic areas. Upland areas which abut open coastal waters, for example, will not require wetland buffers to be included within the management area. Since the wetland buffer requirement was the major reason for extending the boundary further inland, areas where it is not required may have a much narrower boundary.

In this sense the proposed boundary criteria are quite flexible and, therefore, are an improvement over a fixed boundary requirement. The criteria recognizes that some areas are more sensitive than others and require a wider boundary for additional protection. Other areas may be more resilient and can tolerate a much narrower boundary.

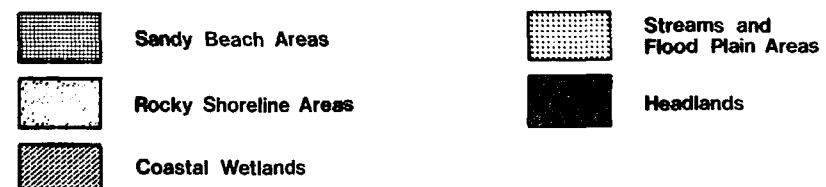


# COASTAL RECREATION

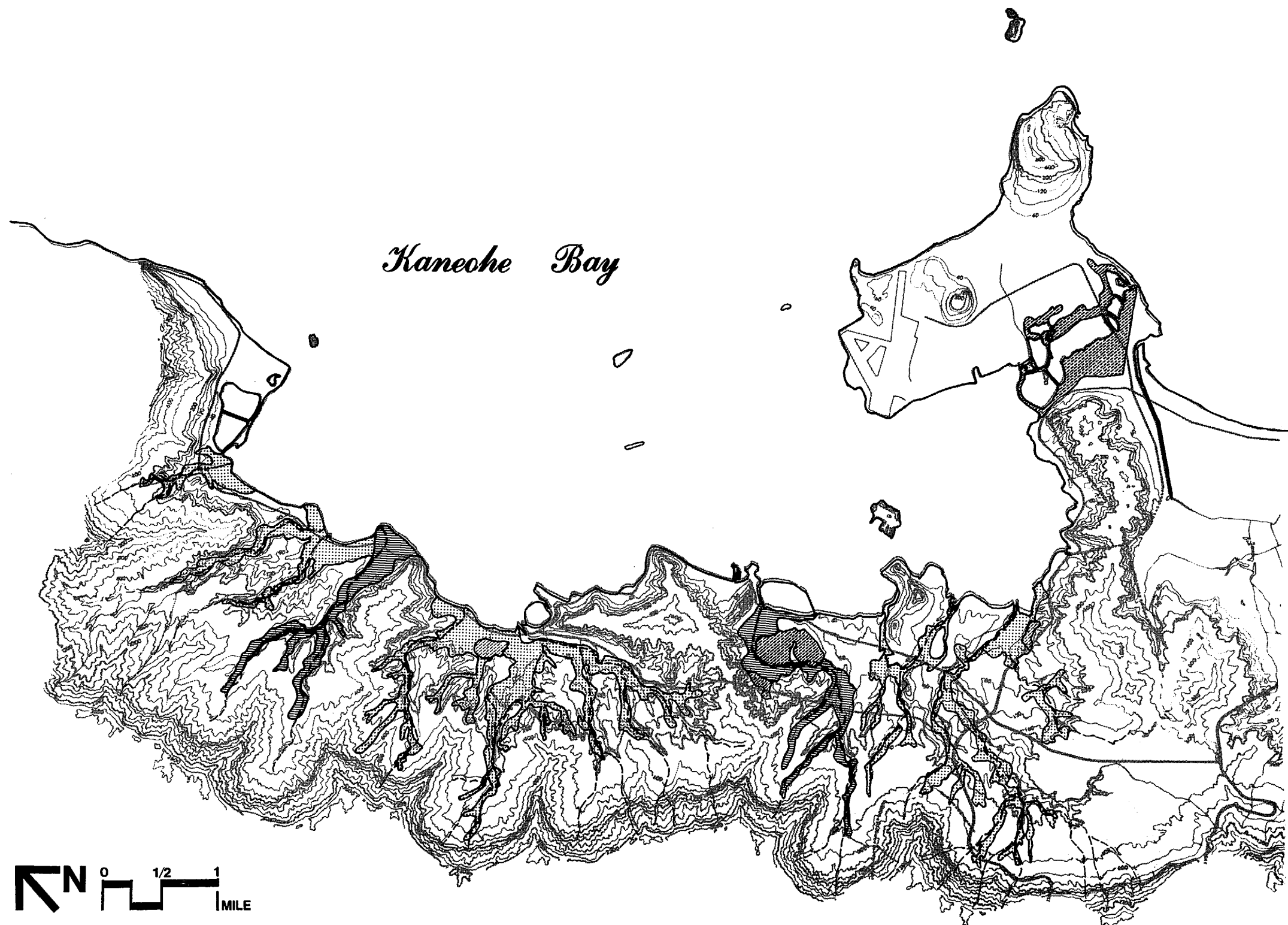
- |   |   |   |   |
|---|---|---|---|
|  | Sandy Beach Areas   |  | Coastal Wetlands  |
|  | Rocky Shoreline Areas   |  | Other perennial streams including channels & adjacent soils which are saturated with water most of the year |
|  | High natural quality perennial streams including channel & adjacent soils which are saturated with water most of the year |   |   |



# **COASTAL SCENIC & OPEN SPACE RESOURCES**







# COASTAL ECOSYSTEMS



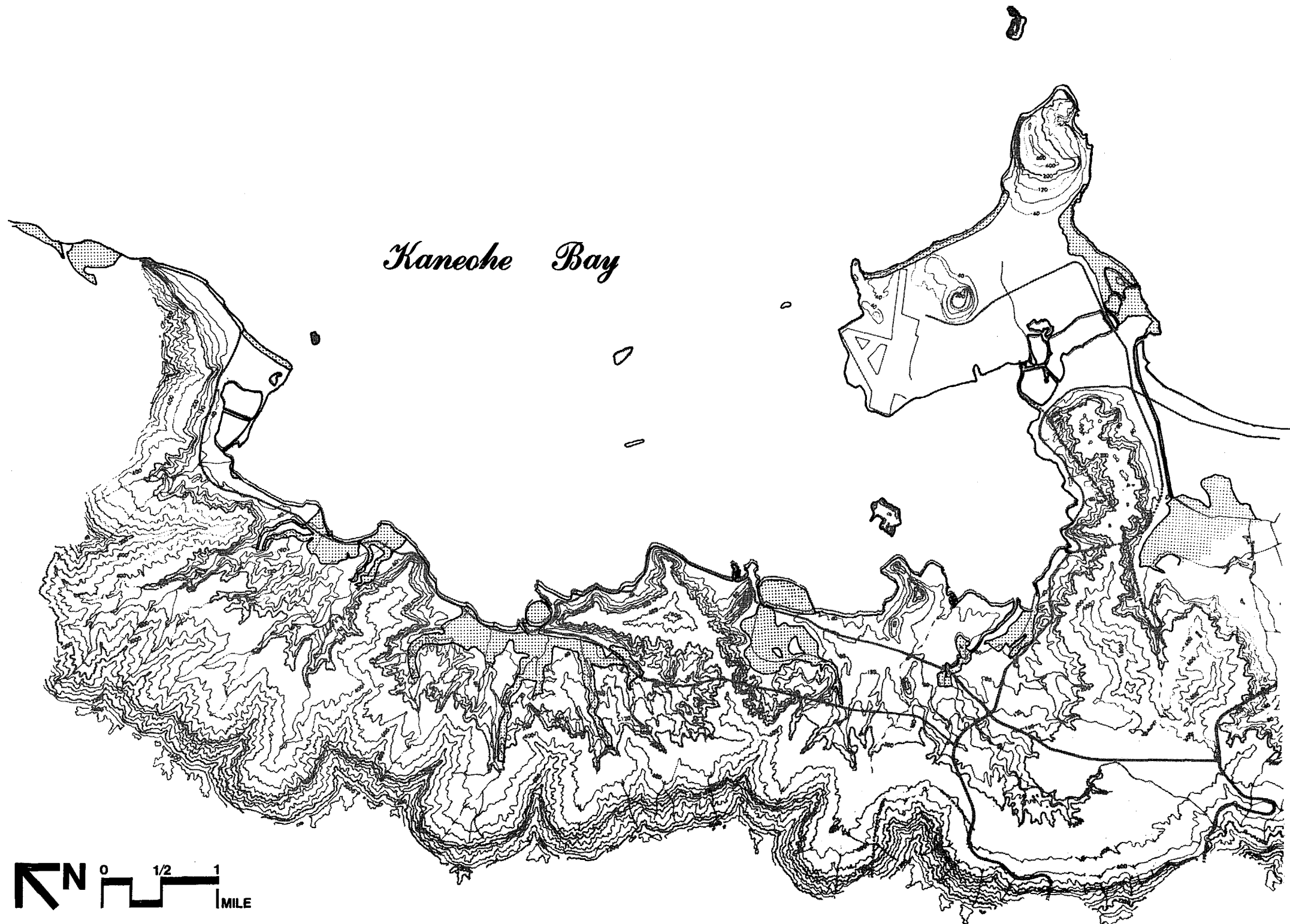
Coastal Wetlands



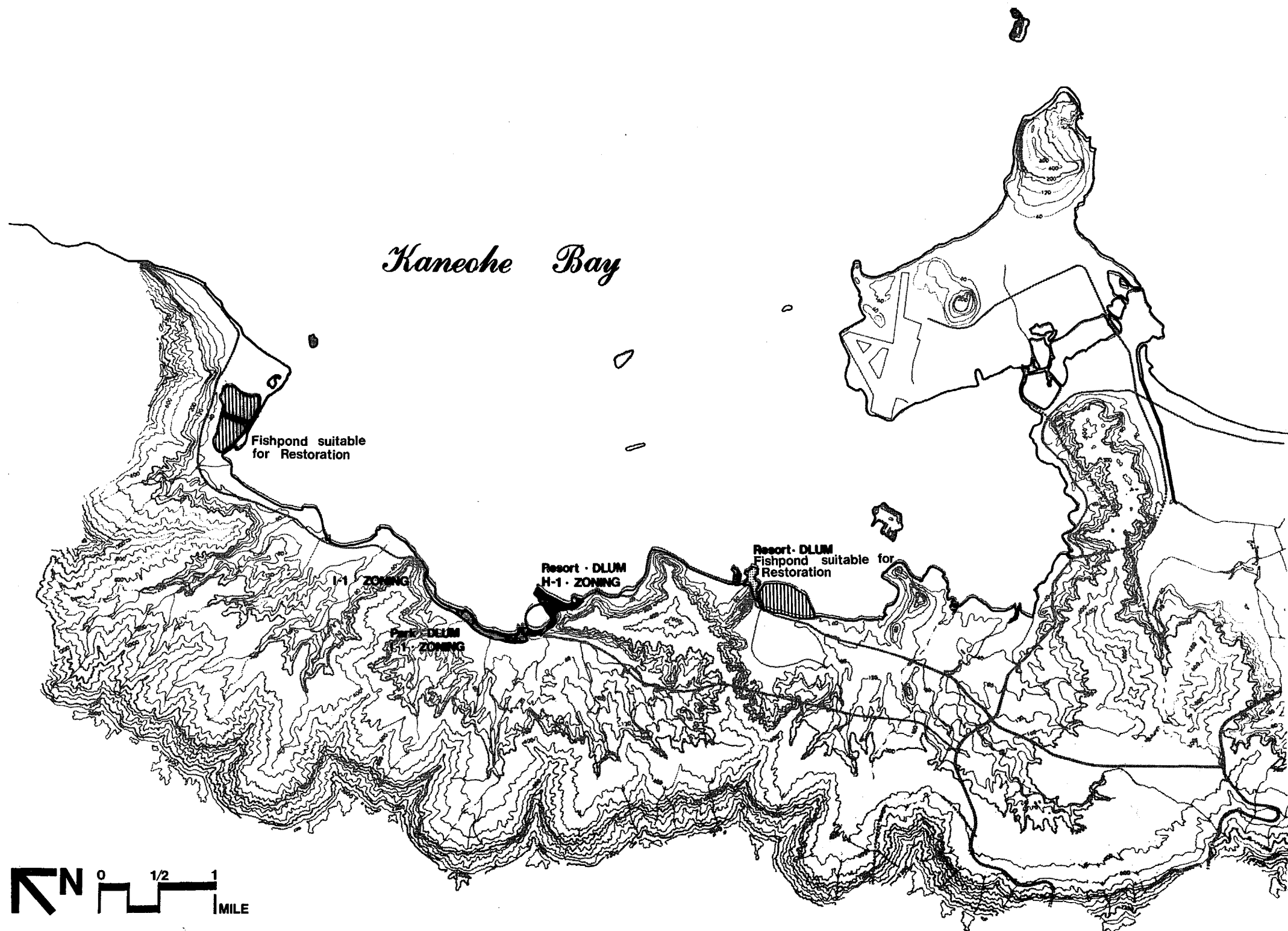
High natural quality perennial streams including channels & adjacent soils which are saturated with water most of the year



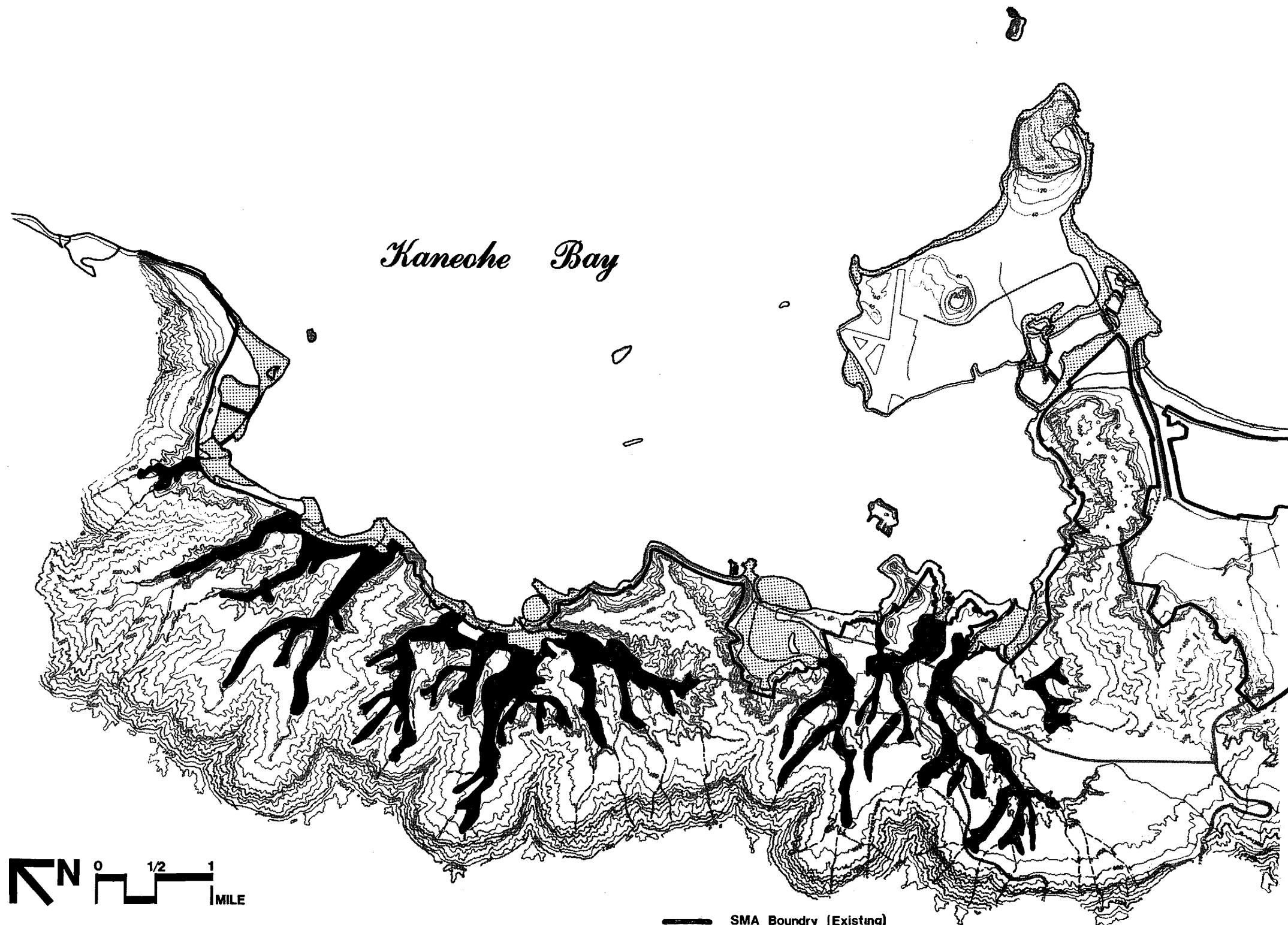
Other perennial streams including channels and adjacent soils which are saturated with water most of the year



## COASTAL HAZARDS



## ECONOMIC ANALYSIS



## SECTION I ENDNOTES

### INTRODUCTION

1. Coastal Zone Management Act of 1972, 16 U.C.S., Sec. 1454 (1972).
2. Ibid.
3. Daniel R. Mandelker, Environmental and Land Controls Legislation, (Indianapolis: The Bobbs-Merrill Company, Inc., 1976), p. 223.
4. Marine Resources and Engineering Development Act of 1966, 33 U.S.C. Sec. 1101-08 (1970).
5. U. S. Commission on Marine Science, Engineering and Resources (the Stratton Commission), Our Nation and the Sea: A Plan for Action, (Washington, D. C.: Government Printing Office, 1969).
6. Panel Report of the Commission on Marine Science, Engineering Resources, Vol. I, Pt. III (Washington, D.C.: Government Printing Office, 1969).
7. Idem, Environmental and Land Use Controls, Legislation, (Indianapolis: The Bobbs-Merrill Company, Inc., 1976), p. 229.
8. U. S. Congress, Senate, Committee on Commerce, Legislative History of the Coastal Zone Management Act of 1972, As Amended in 1974 and 1976, Committee Print, (Washington, D.C.: Government Printing Office, 1976), p. 13.
9. Ibid., p. 14.
10. Idem, Our Nation and the Sea, (Washington, D.C.: Government Printing Office, 1969).
11. The remainder of this section on the national CZMA legislation is based, in part on Mandelker, Environmental and Land Controls Legislation, (Indianapolis: The Bobbs-Merrill Company, Inc., 1976.).
12. The powers given to the state coastal authorities by the federal CZMA enacted in 1972 are quite similar to those recommended by the Stratton Commission in its 1969 report.
13. S. 3183, 91st Congress, 2nd Session, (1970).

14. S. B. 582, 92nd Congress, 1st Session, (1971).
15. American Law Institute, Model Land Development Code, as revised.
16. 117 Cong. Rec. 1652 (1971).
17. 16 U.S.C. SS 1456 (g) (Supp. 1974).
18. S. Rep. No. 92-753, 92nd Cong., 2nd Sess. 7 (1972).
19. H. R. 14146, 92nd Cong., 2nd Sess. (1972).
20. S. 992, 92nd Cong., 1st Sess. (1971); H. R. 4332, 92nd Cong., 1st Session, (1971).
21. S. Rep. No. 92-753, 92nd Cong., 2nd Session 10, (1972).
22. 118 Cong. Rec. 26476 (1972).
23. 118 Cong. Rec H9799 (daily ed. October 12, 1972); 118 Cong, Rec. H9325 (daily ed. October 6, 1972).
24. 16 U.S.C. Sec. 1456 (g) (Supp. 1974).
25. Idem, Environmental and Land Controls Legislation, (Indianapolis: The Bobbs-Merrill Company, Inc., 1976), p. 226.
26. The "federal consistency" provisions are established under the authority of Section 307 of the Federal Coastal Zone Management Act of 1972, as amended. The provisions provide for the state review of federal actions in or significantly affecting the coastal zone. See the federal rules and regulations regarding these provisions, 43 FR10510, March 13, 1978, for further information.
27. Although authorized under Section 309 of the CZMA, funds have not yet been appropriated for a fourth type of grant, which is intended to assist states in the coordination, study, planning and implementation of interstate coastal management programs.
28. Public Law 94-370, the Coastal Zone Management Act Amendments of 1976, made changes in the original federal CZMA, including changes in the requirements for the administration of the federal CZM grants. Grant formulas were increased from a 2/3-1/3 ratio to a 4/5-1/5 ratio, and the period of eligibility for states was increased from 3 to 4 years.

29. The purpose of these sanctuaries is to provide natural field laboratories for gathering data and making studies in the estuaries of the coastal zone. The State of Hawaii has received Section 312 funding for the Waimanu Estuarine Sanctuary on the Island of Hawaii.
30. An element of the CZMA which addresses these concerns is the set of provisions, under Section 308 of the Act, which establishes grants and loans for coastal states to enable them to plan for and respond to onshore impacts resulting from coastal energy activities.
31. 16 U.S.C. Sec. 1453 (a) (Supp. 1974).
32. Idem, Environmental and Land Use Controls, (Indianapolis: The Bobbs-Merrill Company, Inc., 1976), p. 229.
33. 16 U.S.C. Sec 1453 (a) (Supp. 1974).
34. 15 C.F.R. Sec 920.1 (1975).
35. Hawaii, Revised Statutes, Chapter 205 (1975).
36. California, Pub. Res. Code, Sec 3 27001-650 (West. Supp. 1975).
37. Testimony of the DPED to the Senate Committee on Ecology, Environmental and Recreation by Hideto Kono, Director, February 8, 1975.
38. Hawaii, Revised Statutes, Chapter 205 (1975).
39. Hawaii, Revised Statutes, Chapter 205 A-30, as revised.
40. Hawaii, Revised Statutes, Chapter 205A, Part 1, as revised.
41. Hawaii, Revised Statutes, Chapter 205 (1975).
42. Hawaii, Department of Planning and Economic Development, Hawaii Coastal Zone Management Program, First Year Summary Report: 1974-1975, (Honolulu: Department of Planning and Economic Development, 1975), p. 14.
43. This section is based on: Hawaii, Department of Planning and Economic Development, Technical Considerations in Developing a Coastal Zone Management Program for Hawaii, Hawaii Coastal Zone Management Program, Technical Document No. 1 (prepared by the Pacific Urban Studies and Planning Program, University of

Hawaii) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), pp. 13-15.

44. 16 U.S.C. Sec. 1456 (g) (Supp. 1974).
45. Ibid.
46. Idem, Technical Considerations (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 15.
47. Forest reserves are established by Executive Order (Chapter 183, H.R.S.), and include lands set aside or surrendered for forest purposes such as watershed protection, forest products, forest recreation, protection of native plants, and maintenance of fish and wildlife habitat. It has been assumed that direct State control over forest uses assures that no activities conducted by the State on these lands will have spillover impacts on or within coastal waters. Nevertheless, any forest reserve lands falling within current SMA boundaries are considered part of the CZM area and therefore subject to SMA permit approval and mitigation requirements.
48. In May 1978, the Hawaii State Plan (Act 100, SLH 1978), a comprehensive plan for the State was enacted. It is intended to provide a set of long-range goals for the State and to establish a system for coordinating all activities undertaken in both the public and private sectors.
49. Hawaii, Revised Statutes, Sec. 195-1 et. seq.
50. Title III, Public Law 92-583, 86 stat. 1061.
51. 16 U.S.C. Sec 1461.
52. Hawaii, Revised Statutes, Chapter 205, Part II (1975).
53. Hawaii, Revised Statutes, Chapter 206E.
54. Hawaii, Revised Statutes, Chapter 205A-6.
55. The boundary criteria are to be based primarily on Chapter 205A, HRS (1977), and only secondarily on the requirements of the federal CZMA, because the former is obligatory and the latter only optional. Chapter 205A specifically states that any conflicts between the requirements of the two laws must be resolved in favor of Hawaii's law. Moreover, Chapter 205A will remain in effect regardless of whether or not Hawaii's CZM program receives federal approval.



This does not mean, however, that the requirements of the federal CZMA should be ignored. In fact, Chapter 205A aims at compliance with the requirements of the federal law.



## SECTION II ENDNOTES

### A NATIONAL PERSPECTIVE

1. Hereinafter all general references to "states" or "states and territories" participating in the national CZM program include the following states and territories: Alabama, Alaska, California, Connecticut, Delaware, Florida, Georgia, Hawaii, Illinois, Indiana, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Virginia, Washington, Wisconsin, American Samoa, Guam, Puerto Rico, and the Virgin Islands.
2. In the course of implementing a large national program such as the CZM program, many changes and refinements are inevitable--at the federal level through amendments to the National CZM Act, and in its administration by the Secretary of Commerce, the National Oceanic and Atmospheric Administration, and the Office of Coastal Zone Management; as well as the State level through legislative amendments administrative actions and judicial decisions. Because of the dynamic nature of the CZM program, this review of other states 'be viewed in relation to the status of the states' CZM programs at the time the research was conducted. Letters were sent to each of the participating states and territories requesting information concerning their inland boundary. Approximately 70% of the jurisdictions responded between the period of November, 1977 and May, 1978. Information for the others was taken from: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, State Coastal Zone Management Activities 1975-1976, December 1976.
3. U.S., Department of Commerce, National Oceanic and Atmospheric Administration, "State Coastal Management Programs - Development and Approval". Federal Register Vol. 43, no. 41, 1 March 1978. (Hereinafter, all citations of the Federal Register will refer to the above.)
4. Ibid., Section 923.31, p. 8404.
5. U.S. Department of Commerce, Office of Coastal Zone Management, "Threshold Paper #1: Boundaries", Draft, 8 December 1975.
6. Ibid., pp. 5 to 6
7. Information on coastal zone boundary delineation for American Samoa was unavailable - they did not respond to inquiries nor was their program described in the State Coastal Zone Management Activity 1975-1976 (U.S. Department of Commerce).

8. States which utilize the fixed linear distance boundary option for permit purposes include: California, Connecticut, Hawaii, New Hampshire, New Jersey, Puerto Rico, Rhode Island, Washington and the Virgin Islands.
9. California and Puerto Rico are using the fixed linear distance boundary option to determine their planning boundary.
10. States utilizing political/cultural boundaries to delineate a CZM boundary tier for permit purposes include: Connecticut, Hawaii, Illinois, Louisiana, Maryland, Michigan, Mississippi, New Hampshire, New Jersey, New York, Rhode Island and the Virgin Islands.
11. States utilizing existing political/cultural boundaries to delineate a CZM boundary for planning purposes include: Delaware, Florida, Maine, Massachusetts, New Jersey, North Carolina, Pennsylvania, South Carolina, Virginia, Washington, Wisconsin and Puerto Rico.
12. Recent indications are that several states, notably Alaska and Florida, have made significant progress in developing boundaries based on natural processes. Information presented in this section, however, is based on data collected during the research period.
13. It is probable that some or all of these states will justify their final coastal zone boundaries as including areas subject to natural resource management requirements of the Federal Coastal Zone Management Act. Documents available at the end of this study, however, do not contain such justifications.
14. New Hampshire, Office of Comprehensive Planning, The New Hampshire Coastal Zone - A Preliminary Description.
15. Idem, "State Coastal Management Programs" (Federal Register Vol. 43, No. 41, 1 March 1978). Section 923.31, p. 8405.
16. Idem, "State Coastal Management Programs" (Federal Register Vol. 43, No. 41, 1 March 1978). Section 923.31, p. 8405.

### SECTION III ENDNOTES

#### SUMMARY OF ALTERNATIVES FOR INTERPRETING HAWAII'S CZM LAW

1. Coastal Zone Management Act, Section 304, (16 U.S.C. 1453) (1972).
2. Hawaii, Department of Planning and Economic Development, Technical Considerations in Developing a Coastal Zone Management Program for Hawaii, Hawaii Coastal Zone Management Program Document 1 (Prepared by Pacific Urban Studies and Planning Program) (Honolulu: Pacific Urban Studies and Planning Program, 1975), p.
3. The phrase "in the coastal zone management area" also does not appear in the managing development objectives and policies of the Act. The objective and all of the policies of this element, however, do not pertain to boundary delineation issues. They are directed toward management issues which apply irrespective of where the boundary is drawn. This element, therefore, need not be considered for boundary delineation purposes.
4. 'Flood' or 'flooding' means a general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of streams, rivers or other inland water, or abnormally high tidal waters or rising coastal waters proximately caused by severe storms, hurricanes, or tsunamis. It also includes collapse or subsidence of land along the shore of a lake or other body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels. (Part 1909, 36 F.R. 24759, December 22, 1971.)
5. The general term "economic uses" as used in this study and in Act 188 refers to various economic activities which may occur in coastal areas, whether they are "coastal dependent" or not. As will be discussed infrequently, however, "coastal dependent" economic uses will be a key boundary criterion.
6. Hawaii, Department of Planning and Economic Development, 1975 Hawaii State Comprehensive Outdoor Recreation Plan (Prepared by Aotani and Hartwell Associates, Inc.) (Honolulu: Department of Planning and Economic Development, 1975), p.
7. Some may argue that it would not be necessary to include nearly the whole state in the CZM area in order to manage non-point pollution. Such an argument suggests that it would suffice to manage only those areas contributing, or potentially contributing to significant levels of non-point pollution, rather than all possible sources of non-point pollution. Either interpretation is acceptable, given the language of Act 188, however, for the purposes of this study the more area encompassing interpretation was selected as the maximum boundary.

8. A shoreline is a continuous edge separating land and water.  
[Luciano Minerbi, Identifying and Managing the Scenic Resources In Hawaii's Coastal Zone, Technical Supplement No. 8, Hawaii Coastal Zone Management Program (Hawaii: University of Hawaii, Pacific Urban Studies and Planning Program, 1975), p. 143.]
9. Some may argue that visitor industry facilities are not dependent upon coastal location in the same manner or degree as harbors, ports and energy facilities and, hence, would be managed as a "lesser" dependent coastal use. Certainly, many examples of successful landlocked holds around the world could be cited as examples. Nevertheless, such an interpretation would go beyond the "spirit" of Act 188 which explicitly places visitor industry facilities on the same level of consideration as harbors, forts and energy generating facilities.

## SECTION IV ENDNOTES

### BOUNDARY CRITERIA

1. Hawaii, Department of Planning and Economic Development, 1979, Hawaii State Comprehensive Outdoor Recreation Plan (prepared by Aotani & Hartwell Associates, Inc.) (Honolulu: Department of Planning and Economic Development, 1975), p. 3-5.
2. Ibid., p. 70.
3. The ecosystem concept was used in place of identifying individual resources in an attempt to simplify the task. The natural world is so complex and detailed that some form of comprehensive grouping must be made to provide a broad perspective for management purposes. The ecosystem concept allows managers to deal with units of ecological similarity without reducing them to their basic parts of over simplifying natural systems.
4. This chapter is heavily dependent on "An Ecosystem Approach to Water Quality Standards" prepared by the State Department of Health's 208 Technical Committee on Water Quality Standards. While there may be limitations to the particular classifications and ecosystem descriptions provided, no comparable comprehensive treatment of coastal area resources is readily available. [Full citation: Hawaii, Department of Health, 208 Technical Committee on Water Quality Standards, An Ecosystem Approach to Water Quality Standards, (Honolulu: Department of Health, 1977)]
5. Note that resource characteristics identified in Figure 4.1 includes coastal wetland ecosystems associated with standing bodies of brackish water near coasts. These include anchialine ponds and brackish water lakes, both of which are discussed separately from coastal ecosystems. Fresh water bodies in wetland areas are also included in the category of coastal wetlands. Higher altitude fresh water bodies are not required to be part of the coastal zone except as necessary to "control uses which have direct and significant impacts in coastal areas: (Federal Register, Vol. 43, Section 923.30, 1/1/72).
6. Hawaii, Department of Health, 208 Technical Committee on Water Quality Standards, An Ecosystem Approach to Water Quality Standards, (Honolulu: Department of Health, 1977), p. 2.

7. Diadromous species "life and spawn in streams but the hatchlings require marine larval development before they can return to colonize freshwater. [Hawaii, Department of Planning and Economic Development, Hawaiian Coastal Ecosystems: An Element Paper for the Hawaii Coastal Zone Management Study, Hawaii Coastal Zone Management Program Technical Supplement No. 1 (prepared by James E. Maragos et. al.) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 6.]
8. Ibid., p. 11.
9. Mixohaline - Brackish water (0.5 to 30%) created by the mixing of freshwater and sea water.
10. U. S. Army Corps of Engineers, An Ornithological Survey of Hawaiian Wetlands, Vol. I, (prepared by Ahuimanu Productions, Robert J. Shallenberger, principal investigator) (Honolulu: U. S. Army Engineer District, Honolulu, 1977), p. 11.
11. The Laysan duck is the only one of the five listed endangered waterbirds which does not inhabit wetlands on the main islands. It is found on Laysan island in the Leeward archipelago.
12. U. S. Army Corps of Engineers, Wetlands and Wetland Vegetation of Hawaii, (prepared by Margaret E. Elliott and Erin Marie Hall) (Fort Shafter: U. S. Army Corps of Engineers, Pacific Ocean Division, 1977), p. 217.
13. Ibid.
14. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. 13.
15. Hawaii, Department of Planning and Economic Development, Beaches: A Component of the Coastal Zone, Hawaii Coastal Zone Management Program Technical Supplement No. 4 (prepared by Ralph Moberly) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 1.
16. Ibid., p. 1.
17. Sea Grant Marine Advisory Program, Hawaii Coastal Zone News, Vol. 2, No. 10 (February, 1978) (Honolulu: Department of Planning and Economic Development).



18. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. A-50.
19. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. 41.
20. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. A-55.
21. Hawaii Water Resources Regional Study, Environmental Base Study Element Report, (preliminary) (Honolulu: Hawaii Water Resources Regional Study, 1975), p. 49.
22. Hawaii, Department of Planning and Economic Development, The Economy: Analysis of Economic Growth in the State of Hawaii: 1960 to 1990, A Technical Study for the Hawaii State Plan (Honolulu: The Department of Planning and Economic Development, 1977), p. 3-1.
23. Hawaii, Department of Planning and Economic Development, Coastal Resources and Hazards: Identification, Analysis and Recommendations Regarding Management Problems, Hawaii Coastal Zone Management Program Document No. 8 (prepared by the Pacific Urban Studies and Planning Program, University of Hawaii) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1976), p. 18.
24. Ibid., p. 15-16.
25. Surveys include:
  - a. Hawaii, Department of Planning and Economic Development, Hawaii's Treasures, (Honolulu: The Department of Planning and Economic Development, 1971).
  - b. Hawaii, Department of Planning and Economic Development, From the Mountains to the Sea (prepared by Overview Corp.) (Honolulu: Department of Planning and Economic Development, 1972).
  - c. Hawaii Water Resources Regional Study, Environmental Base Study Report for the Hawaii Water Resources Plan, (Honolulu: Hawaii Water Resources Regional Study, 1975).
  - d. Hawaii, Department of Land and Natural Resources, Recreation Program Handbook, (Honolulu: Department of Land and Natural Resources, 1978).

- e. Hawaii, Department of Planning and Economic Development, State of Hawaii Scenic Inventory (prepared by Robert Wenkam) (unpublished photographic inventory).
  - f. Hawaii Visitor Bureau, Master List of Hawaii Visitor Bureau Warrior Markers (unpublished).
26. Idem, Coastal Resources and Hazards, (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1976), p. 15.
  27. Federal CZM grants available upon the approval of Hawaii's CZM Program could be used to develop and implement such a classification system. At that time, existing documents could be used as a basis for a more thorough study involving extensive public input.
  28. Hawaii, Department of Planning and Economic Development, Identifying and Managing the Scenic Resources in Hawaii's Coastal Zone (prepared by Luciano Minerbi) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 143.
  29. Idem, Wetlands and Wetland Vegetation, (Fort Shafter: U. S. Army Corps of Engineers, Pacific Ocean Division, 1977).
  30. Gordon A. Macdonald and Agatin T. Abbott, Volcanoes in the Sea: The Geology of Hawaii, (Honolulu: The University Press of Hawaii, 1970), p. 197.
  31. Idem, Wetlands and Wetland Vegetation, (Fort Shafter: U. S. Army Corps of Engineers, Pacific Ocean Division, 1977).
  32. Idem, An Ornithological Survey, Vol. I, (Honolulu: U. S. Army Engineer District, Honolulu, 1977), p. 2.
  33. Idem, Wetlands and Wetland Vegetation, (Fort Shafter: U. S. Army Corps of Engineers, Pacific Ocean Division, 1977).
  34. Idem, Volcanoes in the Sea, (Honolulu: The University Press of Hawaii, 1970), p. 226.
  35. Idem, Volcanoes in the Sea, (Honolulu: The University Press of Hawaii, 1970), p. 197.
  36. Idem, Volcanoes in the Sea, (Honolulu: The University Press of Hawaii, 1970), p. 198.

37. Paul Bartram, "Beach Erosion: Management Problems and Strategies", Working paper for the Coastal Zone Management Project, Pacific Urban Studies and Planning Program, University of Hawaii, 1977.
38. Derral Herbst, "Vanishing Plants", Water Spectrum, Vol. 9, No. 4, (Fall, 1977).
39. Ibid.
40. Ibid.
41. Idem, "Beach Erosion".
42. An opinion has been expressed by the U. S. Fish and Wildlife Service that critical coastal ecosystem should not be the only criteria used in determining CZM boundaries. In their view, criteria established in Section 923.31 of Federal Register Vol. 43, No. 41 provide for more inclusive coverage of conditions.
43. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. A-152.
44. U. S. Fish and Wildlife Service, Statewide Inventory of Hawaiian Streams Including Survey of Habitat and Associated Biota, Report No. FWS/OBS-78/16, (U. S. Fish and Wildlife Service, 1978), p. iv.
45. Maintenance of Some Minimum flow in streams is also required for a number of beneficial public uses including recreation, agriculture, aquaculture, Fish and Wildlife and Domestic Uses.
46. Hawaii, Department of Planning and Economic Development, Hawaiian Coastal Ecosystems: An Element Paper for the Hawaii Coastal Zone Management Study, Hawaii Coastal Zone Management Program Technical Supplement No. 1 (prepared by James E. Maragos et. al.) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 10.
47. Idem, Statewide Inventory of Hawaiian Streams, (U. S. Fish and Wildlife Service, 1978), p. 2.
48. Idem, An Ornithological Survey, Vol. I, (Honolulu: U. S. Army Engineer District, Honolulu, 1977), p. 11-12.
49. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. A-30.

50. Francis Raymond Fosberg, Field Guide to Excursion III, Tenth Pacific Science Congress, Revised ed., (Honolulu: Department of Botany, University of Hawaii, 1972), p. 35.
51. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. 13-14.
52. Idem, Coastal Resources and Hazards, (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1976), p. 51.
53. Idem, Hawaiian Coastal Ecosystems, (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 13.
54. Idem, Hawaiian Coastal Ecosystems, (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 6.
55. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. A-12.
56. Idem, Hawaiian Coastal Ecosystems, (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1975), p. 7.
57. It is believed that only three spawning beaches are still being used by the green sea turtle on the main islands. These are Halawa Beach (Molokai), Orr's Beach (Hawaii) and Punaluu Beach (Hawaii). [G. H. Balazs, "Terrestrial Critical Habitats for Sea Turtles Under U. S. Jurisdictions in the Pacific Region: An Overview of Existing Knowledge," in press, Elepaio, (Honolulu: The Hawaii Auduborn Society)].
58. Bayard Harlow McConnaughey, Introduction to Marine Biology, 3rd ed., (Saint Louis: C. V. Mosby Company, 1978), p. 132.
59. Three prominent inland water bodies representative of this classification are Nomilo Pond (Kauai), Laysan Lagoon (Laysan Island, Leeward Archipelago) and Lake Kauhako. It should be noted that these types of water bodies have been classified within the general category of coastal wetlands by the Department of Health "208" Technical Committee on Water Quality Standards.
60. It should be pointed out that Nomilo Pond does have a tunnel connection to the sea.
61. Only shoreline erosion is considered explicitly in this paper. While recognizing the upland erosion and resulting sedimentation also impact on the coastal zone, that problem is addressed indirectly in the coastal ecosystems section. CZM efforts in

this area should be coordinated with the "208" water quality management program, counts grading ordinances and the soil and water conservation district effort.

62. The NFIP maps identify the tsunami and stream flooding hazard areas based on the 100-year recurrence frequency. Maps for the City and County of Honolulu have already been prepared; those for the Neighbor Island Counties should be available sometime in the fall of 1978. [Phone conversation with George Kimura of the U. S. Army Corps of Engineers.]
63. The NFIP maps are drawn on large scale maps (1:1,000) which reflect a certain degree of accuracy. On the other hand, the information on erosion and subsidence are available only on general maps not drawn to such a large scale.
64. Hawaii, Department of Planning and Economic Development, Notes on Hawaiian Beach Sand Management, Hawaii Coastal Zone Management Program Technical Supplement No. 12 (prepared by Doak C. Cox) (Honolulu: Pacific Urban Studies and Planning Program, University of Hawaii, 1978), p. 14.
65. Ibid., p. 4.
66. Ibid., p. 4. [Littoral cell - the various parts of an interconnected system of sand production, temporary storage and loss]
67. Idem, "Beach Erosion", Working paper (1977).
68. "Surveys made of the Kalama Beach Park in 1912 and 1961 showed that the shoreline receded 300 feet during the 49-year period" [Idem, "Beach Erosion", Working paper (1977).] This is an extreme example and should incorporate the extent of erosion in other areas during a comparable time period.
69. D. R. Mullineaux and D. W. Peterson, "Volcanic Hazards on the Island of Hawaii", U. S. Geological Survey, Open-file Report No. 74-239 (1974), p. 40.
70. Ibid., p. 41.
71. Ibid., p. 43.
72. Marine Aquaculture is specifically being added to the list because it is obviously coastal dependent in the most literal sense; and, because the State regards aquaculture as a new dynamic growth industry whose development and expansion should

be encouraged. [Idem, The Economy, A Technical Study for the Hawaii State Plan, (Honolulu: The Department of Planning and Economic Development, 1977), p. 9-9 - 9-10.

73. The determination of areas suitable for aquaculture development may not be so simple. Initially the Hawaii Water Resources Plan's list of fishponds which are suitable for restoration may be used for this purpose. [Idem, Hawaii Water Resources, review draft, (Honolulu: Hawaii Water Resources Regional Study, 1977), p. 124.
74. The Hawaii County General Plan maps designate a strip of land which abuts the shoreline approximately 100 yards in width, around the entire island as open space land. Those industrial or resort designated lands directly behind this open space strip should be included within the CZM boundary. Similar situations in other counties should be handled accordingly.
75. Idem, Statewide Inventory of Hawaiian Streams, (U. S. Fish and Wildlife Service, 1978), Appendix A.
76. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1977), p. 13-15.
77. Idem, Statewide Inventory of Hawaiian Streams, (U. S. Fish and Wildlife Service, 1978), Appendix A.
78. Coastal ecosystems of special interest are embayments, wave-sheltered coves, nearshore reef flats, sand beaches and protected coral communities.

## SECTION V ENDNOTES

### GUIDELINES FOR IMPLEMENTING THE CRITERIA

1. Involvement of the county management authority and the state lead agency in the boundary development process is mandated in Act 188: "the authority (County authority administering Chapter 205A, HRS) shall review and amend as necessary its special management area boundaries, subject to lead agency (the Department of Planning and Economic Development) review as to compliance with the objectives and policies of this chapter..." (Section 7b). Public involvement in the process would seem appropriate since public hearings were required for the development of the special management area boundaries (Section 7a). Public hearings, however, are not specifically required by Act 188 in the CZM boundary development process.
2. U.S. Fish and Wildlife Service, Statewide Inventory of Hawaiian Streams Including Survey of Habitat and Associated Biota, Report No. FWS/OBS-78/16 (U.S. Fish and Wildlife Service, 1978).
3. The U.S. Fish and Wildlife Service has recommended that a review committee of the nature described might consist of professionals in various fields of biology, hydrology, water quality, etc.
4. U.S. Army Corp of Engineers, An Ornithological Survey of Hawaiian Wetlands, Volumes I and II (Prepared by Ahuimanu Productions, Robert J. Shallenberger, principal investigator) (Honolulu: U.S. Army Engineer District, 1977), p.
5. Hawaii, Division of Fish and Game/U.S. Fish and Wildlife Service (cooperating), Hawaiian Waterbirds Recovery Plan - Draft, (prepared by Ronald Walker, et al., recovery team) (1977).
6. U.S. Army Corps of Engineers, Wetlands and Wetland Vegetation of Hawaii, (prepared by Margaret E. Elliott and Erin Marie Hall) (1977).
7. Hawaii, Department of Health, 208 Technical Committee on Water Quality Standards, An Ecosystem Approach to Water Quality Standards, Technical Report No. 1 (Honolulu: Department of Health, 1975), pp. 1-61 to A-69.
8. U.S. Department of Agriculture, Soil Conservation Service and the University of Hawaii Agricultural Experiment Station (cooperating), Soil Survey for the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (Washington: U.S. Government Printing Office, 1973), and Soil Survey for the Island of Hawaii, State of Hawaii, (1973)

9. Hawaii, Department of Health, 208 Technical Committee on Water Quality Standards, An Ecosystem Approach to Water Quality Standards (Honolulu: Department of Health, 1977), pp. 13-14.
10. Ibid., pp. A-13 to A-19.
11. Hawaii Water Resources Regional Study, Hawaii Water Resources Plan, review draft (Honolulu: Hawaii Water Resources Regional Study, 1977), p. 50.
12. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1975), pp. A-61 to A-69.
13. Ibid., pp. A-13 to A-19.
14. University of Hawaii, Department of Geography, Atlas of Hawaii, (Honolulu: The University Press of Hawaii, 1973).
15. Gordon A. MacDonald and Agatin T. Abbott, Volcanoes in the Sea, The Geology of Hawaii, (Honolulu: University Press of Hawaii, 1970).
16. Discussed in personal communication with Dr. Derral Herbst, staff botanist, Endangered Species Division, U.S. Fish and Wildlife Service, Region 1-Hawaii.
17. Idem, An Ecosystem Approach, (Honolulu: Department of Health, 1975), pp. A-13 to A-19.
18. G. H. Balazs, "Terrestrial Critical Habitats for Sea Turtles Under U.S. Jurisdictions in the Pacific Region: An Overview of Existing Knowledge", (in press, Elepaio, The Hawaii Audobon Society).
19. As discussed in a telephone conversation with Mr. George Kimura, Hydraulic Engineer, U.S. Army Corps of Engineers.
20. Idem, Hawaii Water Resources Plan, (Honolulu: Hawaii Water Resources Regional Study, 1977), p. 72.
21. Ibid., p. 84.
22. Paul Bartram, "Beach Erosion: Management Problems and Strategies", Working paper for the Coastal Zone Management Project, Pacific Urban Studies and Planning Program, University of Hawaii, 1977.



23. D. R. Mullineaux and D. W. Peterson, "Volcanic Hazards on the Island of Hawaii", U.S. Geological Survey Open File Report, (1974), pp. 74 to 239.
24. For those counties where the general plan is strictly a policy document, another map may have to be substituted for the general plan. In the case of the City and County of Honolulu, for example, Detailed Land Use Maps (DLUMS) should be inserted in place of a general plan.
25. Hawaii, Department of Planning and Economic Development, Office of Tourism, State Tourism Study: Proposal for a Hawaii Tourism Functional Plan, (Honolulu: Department of Planning and Economic Development, 1978).
26. Hawaii, Department of Transportation and the Statewide Transportation Council, Statewide Transportation Plan, Draft (Honolulu: Department of Transportation, 1978).
27. This is not to say that the task is an easy one. The effort will definitely tax the resources of the County Planning Departments quite severely. However, if the effort is made, the boundary criteria described in this paper should not be beyond the reach of the County Planning Departments.



## SECTION VI ENDNOTES

### APPLYING THE CRITERIA

1. Hawaii Environmental Simulation Laboratory, University of Hawaii, Kaneohe Alternatives: An Application of Impact Methodology (Honolulu: Office of Environmental Quality Control, 1974), p. 14.
2. U. S. Army Corps of Engineers, Kaneohe Bay Urban Water Resources Study, Summary Report and Appendices I - V (Honolulu, U.S.) Army Engineer District, Honolulu, 1978).

Other studies were also conducted in conjunction with the above:

- a. U. S. Fish and Wildlife Service, Division of Ecological Services, The Water Dependant Fish and Wildlife Resources in the Kaneohe Bay Area (Honolulu: Division of Ecological Services, 1977) [a supplement to the Kaneohe Bay].
  - b. U. S. Army Corps of Engineers, Draft Kaneohe Bay Data Evaluation Study (prepared by Sanu, Low, Tom and Hara, Inc.) (Honolulu: U. S. Army Engineer District, Honolulu, 1975).
  - c. U. S. Army Corps of Engineers, Kaneohe Bay Recreation Study (prepared by H. Mogi Planning and Research Inc.) (Honolulu: U. S. Army Engineer District, Honolulu, 1977).
  - d. U. S. Army Corps of Engineers, Kaneohe Bay Water Resources: A Plan of Study (Honolulu: U. S. Army Engineer District, Honolulu, 1975).
  - e. U. S. Army Corps of Engineers, Kaneohe Bay Urban Water Resources Study: Community Profits (assisted by Marshall, Kaplan, Gans, Kahn and Yamamoto) (Honolulu, U.S. Army Engineer District, Honolulu, 1975).
3. Hawaii Environmental Simulation Laboratory, University of Hawaii, Kaneohe Alternatives: An Application of Impact Methodology (Honolulu: Office of Environmental Quality Control, State of Hawaii, 1974). [prepared under grants from the Ford Foundation and National Science Foundation].

Several supporting documents were also prepared by HESL (including a number of draft studies which are not listed here but are referenced in Kaneohe Alternatives:

- a. Flood Hydrology in the Kaneohe Bay Area: Background and Models (Bartram, 1972) (WP72-005).
  - Environmental Modeling and Community Interaction (Bauman and Povey, 1973) (WP72-012).
  - Interactive Environmental Modeling (Bauman and Parker, 1973) (WP72-024).
4. Publications by the Hawaii Institute of Marine Biology concerning Kaneohe Bay include:
- a. A Descriptive Study of the Physical Oceanography of Kaneohe Bay, Oahu, Hawaii, Technical Report No. 14 (by Karl H. Bathen) (Honolulu: Hawaii Institute of Marine Biology, University of Hawaii, 1968).
  - b. Interactions Between Seawater and Coral Reefs in Kaneohe Bay, Oahu, Hawaii, Technical Report No. 16 (by Donald G. Klim) (Honolulu: Hawaii Institute of Marine Biology, University of Hawaii, 1969).
  - c. An Annotated Bibliography of Kaneohe Bay, Technical Report No. 20 (by Joleen Aldons Gordon) (Honolulu: Hawaii Institute of Marine Biology, University of Hawaii, 1970).
  - d. Particulate Organic Matter in Kaneohe Bay, Technical Report No. 22 (by Frances Ann Steinhilper) (Honolulu: Hawaii Institute of Marine Biology, University of Hawaii, 1970).
  - e. The Horizontal Distribution of Zooplankton in Kaneohe Bay, Technical Report No. 23 (by David Alan Ziemann) (Honolulu: Hawaii Institute of Marine Biology, University of Hawaii, 1970).
  - f. The Effects of Urban Pollution Upon a Coral Reef System: A Preliminary Report, Technical Report No. 25 (by Albert H. Banner and Julie H. Bailey) (Honolulu: Hawaii Institute of Marine Biology, University of Hawaii, 1970).

In addition to HIMB studies, the Water Resources Research Center, University of Hawaii has also published a number of studies concerning Kaneohe Bay, including:

- a. Effects of Surface Runoff and Waste Discharge (by Edison L. Quan) (Honolulu: Water Resources Research Center, University of Hawaii, 1970).

- b. Bacterial Pollution of Kaneohe Bay, Oahu, Hawaii (by K. K. Ganderson) (Honolulu: Water Resources Research Center, University of Hawaii, 1970).
- c. Water Quality Monitoring: Kaneohe Bay and Selected Watersheds, July to December, 1975 (by Reginald H. F. Young et. al) (Honolulu: Water Resources Research Center, University of Hawaii, 1976).

The Sea Grant Program at the University of Hawaii also has a publication concerning Kaneohe Bay:

- a. Atlas of Kaneohe Bay: A Reef Ecosystem Under Stress (by Stephen V. Smith et. al) (Honolulu: Sea Grant Program, University of Hawaii, 1973).
- 5. Idem, Kaneohe Alternatives (Honolulu: Office of Environmental Quality Control, 1974), p. 14.
- 6. Idem, Kaneohe Alternatives (Honolulu: Office of Environmental Quality Control, 1974). p. 15.
- 7. U. S. Fish and Wildlife Service, Statewide Inventory of Hawaiian Streams Including Survey of Habitat and Associated Biota, Report No. FWS/OBS-78/16, (U.S. Fish and Wildlife Service, 1978), Appendix A.
- 8. Hawaii, Department of Health, 208 Technical Committee on Water Quality Standards, An Ecosystem Approach to Water Quality Standards (Honolulu: Department of Health, 1977), p. A-30.
- 9. U. S. Department of Agriculture, Soil Conservation Service and the University of Hawaii Agricultural Experiment Station (cooperating), Soil Survey for the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii (Washington: U. S. Government Printing Office, 1973), p. 95.
- 10. Ibid., p. 38.
- 11. Ibid., p. 38.
- 12. Ibid., p. 38.
- 13. Ibid., p. 84.
- 14. Ibid., p. 112.

15. Ibid., p. 121.
16. U. S. Army Corps of Engineers, An Ornithological Survey of Hawaiian Wetlands, Vol. II (prepared by Ahuimanu Productions, Robert J. Shallenberger, principal investigator) (Honolulu: U.S. Army Engineer District, 1977), pp. 269, 279.
17. U. S. Army Corps of Engineers, Kaneohe Bay Recreation Study (prepared by H. Mogi Planning and Research, Inc.) (Honolulu: U.S. Army Engineer District, Honolulu, 1977). p. 42.
18. U. S. Army Corps of Engineers, Wetlands and Wetland Vegetation of Hawaii (prepared by Margaret E. Elliott and Marie Erin Hall) (Fort Shafter: U.S. Army Corps of Engineers, Pacific Ocean Division, 1977). pp. 86, 89, 94, 97.
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